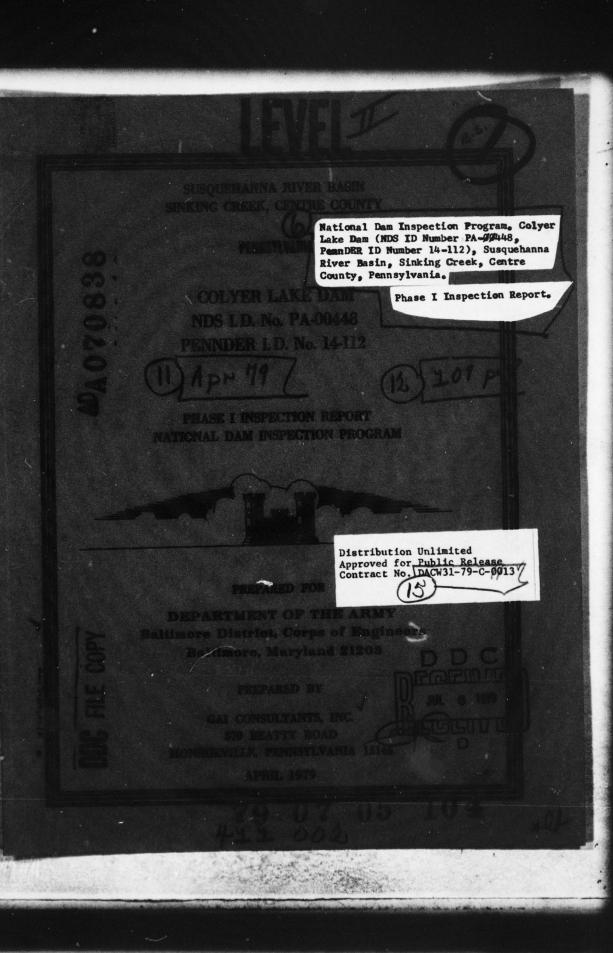
GAI CONSULTANTS INC MONROEVILLE PA
NATIONAL DAM INSPECTION PROGRAM. COLYER LAKE DAM (NDS ID NUMBER--ETC(U)
APR 79
DACW31-79-C-0013 AD-A070 838 UNCLASSIFIED NL 1 oF 2 AD A070838 E#



#### PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest resonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

# PHASE I REPORT NATIONAL DAM INSPECTION PROGRAM

#### ABSTRACT

Colyer Lake Dam NDS I.D. No. PA-00448

Owner: Pennsylvania Fish Commission

State Located: Pennsylvania (PennDER I.D. No. 14-112)

County Located: Centre County

Stream: Sinking Creek

Inspection Date: 13 November 1978

Inspection Team: GAI Consultants, Inc.

570 Beatty Road

Monroeville, Pennsylvania 15146

The visual inspection, operational history, and hydrologic/hydraulic analysis indicate the facility is in good condition. A maintenance manual, operations manual, and emergency operations plan are available or are being developed for the facility. The emergency plan reviewed by the inspection team appears insufficient in that it lacks several critical items. Deficiencies noted during the inspection include cracking and spalling in the spillway weir section and sidewalls and minor cracking within the outlet conduit.

Based on the recommended guidelines, the Spillway Design Flood (SDF) for this facility is the Probable Maximum Flood (PMF). Hydrologic and hydraulic calculations performed for this Phase I study indicate that the discharge/storage capacity of the dam can accommodate a flood of magnitude equal to about 77 percent of the PMF prior to overtopping of the dam. Therefore, the spillway system is considered to be inadequate.

It is recommended that the owner:

- a. Repair the spalled areas of the spillway weir and seal all cracks in the weir and spillway sidewalls.
- b. Evaluate the cracking within the outlet conduit during subsequent periodic inspections and take remedial action if deteriorating conditions are observed.



c. Reevaluate and revise the present emergency plan for Colyer Lake in accordance with, but not limited to, the items listed in Section 4.5.

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GAI Consultants, Inc.

Approved by:

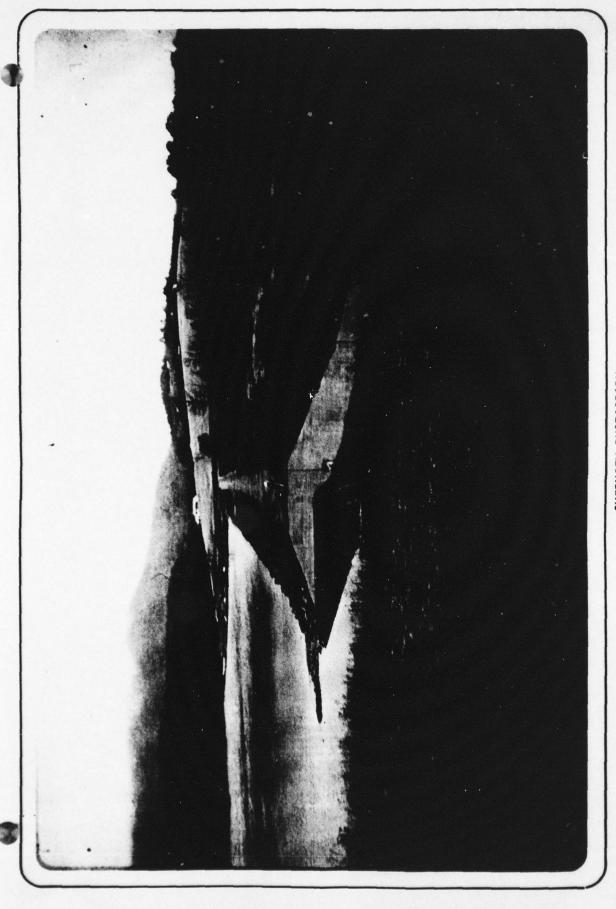
Colonel, Corps of Engineers

District Engineer



Date 22 MARCH 79

Date 17 Apr 79



OVERVIEW PHOTOGRAPH
v

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# PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION REPORT COLYER LAKE DAM NDI# PA-448, PENNDER# 14-112

# SECTION 1 GENERAL INFORMATION

## 1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

## 1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

# 1.2 Description of Project.

a. Dam and Appurtenances. Colyer Lake Dam is a zoned earth embankment approximately 38 feet high and 700 feet long. Including the spillway system, the length of the facility is approximately 780 feet. (see Figure 1).

The dam is provided with an ungated concrete rectangular spillway and plunge pool located on the right abutment. The spillway consists of a 69-foot wide trapezoidal weir section aside a 10-foot wide rectangular flume section (inside dimensions), separated by a concrete wall (see Figure 10 and Photograph 6). The outlet works consist of a 4-foot square reinforced concrete outlet connected to a rectangular vertical riser. Discharge through the outlet is controlled by stop logs that are set in grooves within the riser.

b. Location. Colyer Lake Dam is located on Sinking Creek, Potter Township, Centre County, Pennsylvania, about 11 miles east of State College. The dam and reservoir are contained within the Centre Hall, 7.5 minute U.S.G.S. topographic quadrangle. The coordinates of the dam are N40° 46' 50" and W77° 40' 50" (see Regional Vicinity Map, Appendix G).

[CONTID ON

P. 11 ]

c. Size Classification. Intermediate (38 feet high; maximum reservoir storage capacity 1,730 acre-feet).

- d. Hazard Classification. High (see Section 3.1.c.4).
- e. Ownership. Pennsylvania Fish Commission
  P. O. Box 1673
  Harrisburg, Pennsylvania 17120
- f. Purpose. Recreation and research.
- g. <u>Historical Data</u>. Colyer Lake Dam was constructed in the period of October 1964 to September 1966. Both the design and construction of the facility were undertaken by Pennsylvania Fish Commission staff. Periodic progress reports were issued by the Pennsylvania Fish Commission, Office of Engineering, and the construction site was frequently visited by PennDER personnel. No indications of problems are contained within the available PennDER correspondence and the project was completed as scheduled.

In 1968, the concrete wall separating the trapezoidal weir section from the by-pass canal section was replaced as it was damaged by ice pressure. Current practice is to lower the lake level each winter (as was the condition at the time of inspection) for ice protection.

#### 1.3 Pertinent Data.

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- a. Drainage Area. 8.4 square miles.
- b. <u>Discharge at Dam Site</u>. Discharge records are not available.
- c. Elevation (feet above mean sea level). The following elevations were obtained through field measurements that were based on the elevation of the emergency spillway crest at 1244.0 feet (see note on Sheet 3, Appendix C).

Top of Dam = 1252 (top of spillway wingwall).

Maximum Pool Design Surcharge - Not known.

Maximum Pool of Record - Not known.

Spillway Crest ≈ 1244.

Invert of Upstream End of Outlet Conduit = 1211.

Invert of Downstream End of Outlet Conduit = 1209.

Streambed at Centerline of Dam = 1211.

Maximum Tailwater - Not known.

#### d. Reservoir Length (miles).

Maximum Pool = 0.8 (elevation 1252.0)

Normal Pool = 0.6 (elevation 1244.0)

#### e. Storage (acre-feet).

Spillway Crest = 1010 (elevation 1244.0)

Top of Dam  $\approx$  1730 (does not include approximately 18 acre-feet of storage provided by the adjacent by-pass canal).

#### f. Reservoir Surface (acres).

Spillway Crest = 77 (elevation 1244.0)

Top of Dam = 105 (elevation 1252.0)

#### g. Dam.

Type - Earth.

Length  $\simeq$  700 feet (field measured); 740 feet (design).

Height = 38 feet (field measured); 45 feet (design).

Top Width = 15 feet (field measured); 18 feet (design).

Side Slopes - Upstream: 3H:1V
Downstream: 2.5H:1V

Zoning - Four zones are denoted on the contract drawings and specifications (see Figure 6).

Class A Fill - Upstream of core - semi-impervious material free from rocks greater than 6 inches in maximum dimension.

Class B Fill - Downstream of core - selected semiimpervious material free from rocks greater than 12 inches in maximum dimension.

Selected Impervious Fill - Selected impervious and structurally sound material free from vegetable matter and rock greater than 4 inches in maximum dimension.

Selected Pervious Material - Mantles the downstream face - selected pervious material sufficiently pervious to drain the embankment and may contain rocks up to 12 inches in diameter.

Impervious Core - See "Zoning" and Figure 6.

Cutoff - A cutoff extending a minimum depth of 4 feet into rock was constructed along the centerline of the dam (see Note 8, Figure 6).

Grout Curtain - None.

h. <u>Diversion Canal</u>. By-pass canal constructed along the east side of the reservoir which combines with the spillway system.

## i. Outlet Conduit.

0

Type - 4-foot square concrete box culvert.

Length = 216 feet, inlet to outlet.

Closure - Discharge through the outlet is controlled by 6-inch by 6-inch by 5-foot oak stop logs set in grooves within the concrete riser.

Access - Riser accessible from crest.

# j. Spillway.

Type - Rectangular concrete chute channel with trapezoidal-shaped crest aside a 10-foot rectangular flume section.

Width - Trapezoidal weir section: 69 feet Rectangular flume section: 10 feet

Channel Length = 142 feet (channel section)
45 feet (stilling basin section)

Crest Elevation ≈ 1244.

Upstream Channel - Cut in soil and rock.

Downstream Channel - Spillway discharges into the original Sinking Creek streambed.

k. Regulating Outlets. Flow through the 4-foot square discharge conduit is regulated with stop logs. A

flashboard system is located at the upstream end of the reservoir which can be used to regulate flow into the bypass canal (see Photograph 9 and "Log Dam" on Figure 2).

#### SECTION 2 ENGINEERING DATA

#### 2.1 Design.

#### a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. Design calculations are available from PennDER and Fish Commission files.

A report titled, "Engineering Feasibility Report of a Proposed Dam and Lake on Sinking Creek, Potter Township, Centre County, Pennsylvania," is also available from Fish Commission files.

2. Embankment. No design calculations are available. Contract drawings contain some subsurface information and boring logs are available from Fish Commission files.

#### Design Features.

l. Embankment. The contract drawings indicate that the embankment is a zoned earth structure 45 feet high having a total embankment length of 740 feet. (Field measurements yielded a length of 700 feet and a height of 38 feet.)

The structure consists of two semi-impervious zones surrounding a zone of select impervious material. A cutoff trench was excavated along the centerline of the dam to a depth of at least 4 feet below the top of rock. A zone of pervious material mantles the downstream slope as shown on Figure 6. A toe drain comprised of sand, gravel, fine rock fragments, and 6-inch diameter perforated pipe underlies the pervious material and discharges near the outlet structure.

The dam is 15 feet wide at the crest and has slopes of 3H:1V upstream and 2-1/2H:1V downstream. Dumped riprap on crushed stone bedding protects the upstream face of the dam.

2. Appurtenant Structures. The outlet works at Colyer Lake Dam consist of a reinforced concrete riser and horizontal box culvert which discharges into a fish catch basin at the toe of the dam (see Figure 9 and Photographs 5 and 8). The culvert is a 4-foot square reinforced concrete structure with seep collars at 25-foot intervals. The riser portion is a rectangular structure containing grooves for stop log installation.

The spillway is a rectangular concrete chute with a 69-foot wide trapezoidal weir section and a 10-foot wide rectangular flume section (see Figure 10 and Photograph 6) which accepts flow from the by-pass canal. The right retaining wall of the trapezoidal weir section (left wall of flume section) will act as a side channel spillway during flood flows and will discharge flow into the rectangular flume. Ungated discharge from the spillway empties into a stilling basin before entering the original streambed downstream of the dam.

#### c. Design Data and Procedures.

- l. Hydrology and Hydraulics. Calculations contained within PennDER and Fish Commission files indicate that the Pennsylvania "C" Curve was used as the basis for designing the spillway.
  - 2. Embankment. No design data are available.
- 3. Appurtenant Structures. No design data are available.

#### 2.2 Construction Records.

Contract drawings, specifications, construction progress reports, and construction photographs are available from PennDER and Fish Commission files.

#### 2.3 Operational Records.

Operational records such as spillway discharge are not available for the facility.

#### 2.4 Other Investigations.

The following is a list of additional studies of the facility prior to and subsequent to construction, all of which are available from Fish Commission Files in Bellefonte, Pennsylvania.

Preliminary Report of a Reconnaissance Survey, 1954, by O'Hara and Trembley.

Biological Inspection, 1953, by Arthur Bradford.

Engineering Feasibility Report, 1964, by Edward Miller.

Results of Subsurface Explorations, 1964, F. J. Kitlinski and Associates.

Report on Wall Damage Due to Ice Pressure at Colyer Lake, 1968, by Ray R. Frank.

Analysis of Colyer Lake Spillway, 1974, by E. J. Grindall.

#### 2.5 Evaluation.

Engineering data in the form of drawings, specifications, hydrologic and hydraulic calculations, construction photographs, and correspondence are available from Fish Commission and PennDER files. The data available are considered adequate to make a reasonable Phase I assessment of the facility.

#### SECTION 3 VISUAL INSPECTION

#### 3.1 Observations.

- a. General. The general appearance of the structure, based on the visual inspection, suggests that it is in good condition.
- b. Embankment. The upstream face of Colyer Lake Dam is sloped at 3H:1V and is protected by durable sandstone riprap (see Photograph 2); whereas, the downstream face is sloped at 2.5H:1V and is protected by a well established cover of crown vetch. The crest of the dam is seeded and is approximately 15 feet wide.

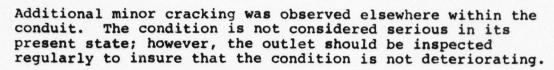
No signs of seepage were observed at the time of inspection nor were any signs of slope distress noted. Both toe drains were functioning and discharging into the fish catch basin downstream of the outlet conduit.

#### c. Appurtenant Structures.

1. Spillway. The visual inspection of the spillway revealed that it is in need of minor repair. Cracking and spalling of the trapezoidal weir section was evident as shown in Photograph 7. Cracking and efflorescence were particularly associated with the weep holes in the spillway sidewalls. There was also minor cracking in the wall separating the flume section from the trapezoidal weir section of the spillway.

At the time of inspection, the Pennsylvania Fish commission was drawing down the reservoir so as to drain the forebay of the spillway. This is done every winter to reduce ice pressures on the wall separating the trapezoidal weir section and flume section of the spillway. The wall was replaced in 1968 following ice damage (see Figure 11).

2. Outlet Conduit. Discharge through the outlet works at Colyer Lake Dam controlled by stop logs within the vertical riser (see Photograph 4). The Fish Commission was lowering the reservoir level at the time of inspection; consequently, only the exposed portion of the vertical riser could be inspected. Field team members did enter the horizontal portion of the 4-foot square outlet conduit to a point about 10 feet from the vertical riser. Cracking and efflorescence were observed within the conduit approximately 10 to 15 feet downstream of the riser (Figure 7 indicates a concrete cutoff collar extends into rock in this area).



- 3. Reservoir Area. The reservoir is surrounded by forested slopes which range from steep to gentle (see Photograph 3). Some surficial sliding was observed on the west side of the reservoir; however, the condition is not considered serious.
- 4. Downstream Area. Discharge from Colyer Lake flows through the broad floodplain of Sinking Creek (see Photograph 8) which is surrounded by gently rolling hills used primarily for agriculture. At a point approximately 2,500 feet downstream of the dam, Sinking Creek passes beneath a bridge on a secondary road in the community of Colyer. A home (see Photograph 10) and a church are located in this area with first floor levels less than 10 feet above the stream bottom.

Because of the position of the above-mentioned improvements, the facility was given a "high" hazard classification.

#### 3.2 Evaluation.

The overall appearance of the facility indicates that it is in good condition. The spillway requires repair on the trapezoidal weir section where significant spalling and cracking has occurred (see Photograph 7). Cracking and efflorescence within the spillway and outlet conduit should be observed in subsequent inspections to insure that the condition does not deteriorate.

# SECTION 4 OPERATIONAL PROCEDURES

## 4.1 Normal Operational Procedures.

According to representatives of the Pennsylvania Fish Commission, an operations manual is being prepared for the facility although it was not available for review by the inspection team.

Under normal conditions, the stop logs within the control tower are set at 4 inches above the crest elevation of the spillway. Excess inflow passes over the spillway and enters the Sinking Creek channel downstream of the dam.

Each fall the water level is lowered approximately 4 feet thereby draining the forebay area. This is done to reduce the chance of ice damage to the wall separating the flume and trapezoidal weir sections of the spillway (see Section 3 for details).

Continuous flow through the by-pass canal is regulated for water quality and research purposes.

### 4.2 Maintenance of Dam.

Pennsylvania Fish Commission personnel indicate the standard Soil Conservation Service Manual is used as a maintenance guideline. Written records of maintenance are prepared on a routine basis by Fish Commission personnel.

# 4.3 Maintenance of Operating Facilities.

See "Maintenance of Dam" above.

#### 4.4 Warning Systems.

Emergency plans are currently being developed for Pennsylvania Fish Commission dams. The plan for Colyer Lake Dam is as follows:

The Centre County waterways patrolman or a deputy patrolman shall observe this structure during periods of heavy precipitation. Should they observe any of the following conditions, they are instructed to notify the PennDER Regional Office at Williamsport, Pennsylvania, (telephone

- 717/326-2681, Extension 258 or call 717/326-9787 after hours).
- a. Sliding of upstream or downstream slopes or abutments contiguous to the dam;
  - b. Sudden subsidence of the crest of the dam;
- c. Longitudinal or transverse cracking of the crest of the dam;
- d. Unusual release of water from the face or toe of the dam;
- e. Any other unusual conditions at the downstream slope of the dam;
  - f. Significant landslides in the reservoir area; or
  - g. Unusual discharges through the spillway system.

#### 4.5 Evaluation.

According to Fish Commission personnel, an operations manual is being prepared and the facility receives periodic maintenance in accordance with SCS guidelines. Records of maintenance are available at the Pennsylvania Fish Commission office in Bellefonte, Pennsylvania. Emergency plans are being developed for all Fish Commission dams. The current plan for Colyer Lake Dam as presented in Section 4.4 appears insufficient in several aspects and should be given additional scrutiny. Some specific items which should be addressed are:

- a. Definition of alert stages which are related to pool level.
- b. A mechanical/electrical device at the dam which is operable at any or all hours of the day to signal the designated patrolmen that an alert stage has developed.
- c. Alternate means of communication in the event telephone lines are inoperable.

# SECTION 5 HYDROLOGIC/HYDRAULIC EVALUATION

#### 5.1 Design Data.

Minimal spillway design data are available. Calculations and correspondence indicate that the spillway was designed to pass a peak flow of 6,872 cfs as determined by the Pennsylvania "C" Curve criteria. The combined flow through the canal section and over the trapezoidal-shaped weir was determined to be 6,973 cfs. No routing of the design flood was performed.

#### 5.2 Experience Data.

No records of discharge are available for this facility. The "Agnes" storm of June, 1972, is thought to be the greatest storm experienced by the facility and damage was limited to dislocation of riprap in the fish catch basin.

# 5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway and outlet system would not perform satisfactorily during a flood event.

#### 5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

## 5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I investigations, the Spillway Design Flood (SDF) for Colyer Lake Dam is the Probable Maximum Flood (PMF). This classification is based on the relative size of the dam (intermediate), and the potential hazard of dam failure to the downstream residences (high).

b. Results of Analysis. Colyer Lake Dam was evaluated under near normal operating conditions. That is, the Colyer Lake Reservoir was initially at its normal pool or emergency spillway elevation of 1244.0 feet (MSL), but the usually operational 4-foot square low level outlet was assumed to be non-functional for purposes of analysis (Appendix C, Sheets 9 and 10). Potential reservoir storage values were estimated based on the available 5-foot contour map of the facility (Figure 2). The spillway weir crest-shape was assumed to approximate that of an ogee crest in order to develop a discharge-elevation relationship.

A 2,400-foot by-pass canal with significant discharge and moderate storage capacities aids in the drainage of the 8.4 square mile basin above Colyer Lake Dam. In order to consider its effects on reservoir inflows, the potential storage and corresponding discharge values of the by-pass canal were added to the reservoir values at appropriate elevations (Appendix C, Sheets 11-17, and 19). All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix C.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Colyer Lake Dam could accommodate only about 77 percent of the PMF prior to overtopping of the dam (Appendix C, Summary Input/Output Sheets, Sheet D). The peak PMF inflow of about 9720 cfs was attenuated by the discharge/storage capabilities of the dam and reservoir such that the resulting peak outflow was about 9650 cfs (Summary Input/Output Sheets, Sheets B and C). Under the PMF, the embankment was overtopped for approximately 5.3 hours, with a maximum depth of inundation equal to about 0.7 feet (Summary Input/Output Sheets, Sheet D).

# 5.6 Spillway Adequacy

Although Colyer Lake Dam could not accommodate its SDF (the PMF), the possible downstream consequences of embankment failure due to overtopping were not evaluated. Breaching analysis of the dam was not performed in accordance with ETL-1110-2-234, since the facility can safely pass a flood of at least 1/2 PMF magnitude. Since Colyer Lake Dam cannot accommodate a PMF-size flood, its spillway is considered to be inadequate.

# SECTION 6 EVALUATION OF STRUCTURAL INTEGRITY

#### 6.1 Visual Observations.

- a. Embankment. Based on the visual inspection, the dam appeared to be in good condition. No signs of seepage or slope distress were noted at the time of inspection nor is there any record of problems with the structure in available Fish Commission and PennDER records.
- b. Appurtenant Structures. In 1968, the wall separating the trapezoidal weir section and flume section of the spillway was replaced following damage incurred from ice pressures within the forebay. Since that time, the Pennsylvania Fish Commission has lowered the water level about 4 feet in the late autumn to drain the forebay prior to the winter season.

The spillway, spillway sidewalls, and stilling basin are generally in good condition, one notable exception being the cracking and spalling on the trapezoidal weir section (see Photograph 7). Minor cracking and efflorescence were also noted at numerous locations on the spillway side walls particularly at the sidewall weep holes.

The horizontal portion of the outlet conduit was inspected by entering the 4-foot square conduit from the outlet end. Minor cracking, staining, and efflorescence were observed throughout the conduit particularly at a point about 10 to 15 feet from the connection with the vertical riser. The vertical riser and impact area could not be inspected because water was discharging over the stop logs at the time of inspection. Periodic inspections of the outlet conduit should be continued.

## 6.2 Design and Construction Techniques.

Design computations are available for the outlet system which indicate the spillway was sized using the Pennsylvania "C" Curve. No other design data are available although contract drawings, specifications, and construction photographs were reviewed.

#### 6.3 Past Performance.

Pennsylvania Fish Commission records indicate adequate past performance of the facility although some riprap was

displaced in the fish catch basin area following the "Agnes" storm in June, 1972.

# 6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and is subject to minor earthquake induced dynamic forces. As the dam is broad based, constructed of rolled earth and rockfill, and contains provisions for internal drainage, the static stability is thought to be sufficient to withstand minor earthquake induced dynamic forces. No calculations or investigations, however, were performed to confirm this opinion.



#### 7.1 Dam Assessment.

a. Safety The visual inspection, operational history, and hydrologic/hydraulic analysis indicate that the structure is in good condition. A maintenance manual, operations manual, and emergency operations plan are available or are being developed for the facility. The emergency plan reviewed by the inspection team appears insufficient in that in lacks critical items, several of which are listed in Section 4.5. Deficiencies noted curing the inspection were limited to cracking and spalling of the spillway weir and sidewalls and minor cracking within the outlet conduit.

Hydrologic and hydraulic calculations indicate that the spillway system (including by-pass canal) will pass and/or store only about 77 percent of the PMF prior to overtopping of the dam. Since the SDF of the facility is the PMF, the spillway system is deemed inadequate.

- b. Adequacy of Information. The available data (contract drawings, specifications, photographs and miscellaneous correspondence) are considered sufficient to make a reasonable Phase I evaluation of the facility.
- c. Urgency. Remedial repairs to the spillway surfaces as indicated below should be performed as soon as practical.
- d. <u>Necessity for Additional Investigations</u>. No additional investigations other than routine maintenance checks are deemed necessary at this time.

#### 7.2 Recommendations/Remedial Measures.

It is recommended that the owner:

- a. Repair the spalled areas on the spillway weir and seal all cracks in the weir and spillway sidewalls.
- b. Evaluate the cracking in the outlet conduit during subsequent periodic inspections and take appropriate remedial measures if deteriorating conditions are observed.
- c. Reevaluate and revise the present emergency plan for Colyer Lake in accordance with, but not limited to, the items listed in Section 4.5.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Colyer Lake Dam
ND1#: PA-448 PENNDER#: 14-112

CHECK LIST ENGINEERING DATA PHASE I

PAGE 1 OF 5

REMARKS ND1# PA - 448	<ol> <li>Dan O'Neill - Chief of Property Maintenance Branch, Pennsylvania Fish Commission (at dam).</li> <li>Charles Hess - Area 5 Maintenance Supervisor (at dam).</li> <li>John Grindall - Engineer Pennsylvania Fish Commission (at Bellefonte Office).</li> </ol>	U.S.G.S. 7.5 minute series topographic quadrangle Centre Hall, Pennsylvania (see Regional Vicinity Map, Appendix G).	Built in 1966 by PFC (force account); supervised by Gene Smith (P.E.) of PFC (Chief of Construction and Maintenance).  PFC has construction photographs, specifications, engineering feasibility report, and progress reports.	Set of 12 as-built drawings available from the Bellefonte office of the Pennsylvania Fish Commission.	See Figure 6, Appendix F.	See Figures 7 and 8, Appendix F. Discharge ratings not indicated.
ITEM	PERSONS INTERVIEWED AND TITLE	REGIONAL VICINITY MAP	CONSTRUCTION HISTORY PFC PFC PFC FC F	AVAILABLE DRAWINGS	TYPICAL DAM SECTIONS See Figure	OUTLETS: PLAN DETAILS DISCHARGE RATINGS

ENGINEERING DATA (CONTINUED)

ENGINEERING DAIA CO	DATA (CONTINUED)
ITEM	REMARKS NDI# PA - 448
SPILLWAY: PLAN SECTION DETAILS	See Figures 3 and 10, Appendix F. See Figure 10, Appendix F. See Figures 10 and 11, Appendix F.
OPERATING EQUIPMENT PLANS AND DETAILS	Controlled via stop logs, see Figure 7, Appendix F.
DESIGN REPORTS	The following reports are available at PFC Bellefonte Office:  1. Preliminary Report of a Reconnaissance Survey (O'Hara & Trembley)  2. Biological Inspection, Arthur Bradford, 1953.  3. Engineering Feasibility Report, Edward Miller, 1964.  4. Analysis of Colyer Lake Spillway, E. J. Grindall, 1974.
GEOLOGY REPORTS	Geology mentioned briefly in Engineering Feasibility Report (see 3 above).
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	Available from PennDER and PFC files.  None available.  None available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	<pre>Xitlinski and Associates drilled 14 borings, 2 field perm. tests, 6 borings pressure tested. (Logs available at PFC, Bellefonte Office.) No compaction tests of record.</pre>

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ATA (CONTINUED)	REMARKS NOI# PA - 448	Within reservoir - See Figure 2, Appendix F.	TION None.	Report on diversion wall damage by R. R. Frank (PFC).  EPORTS Analysis of Colyer Lake Spillway, E. J. Grindall (PFC).	ORDS Not known - High pool to date most probably occurred in June 1972 according to PFC personnel.	STEMS None.	Re-built center wall in spillway and deleted stop plank opening (1968).
ENGINEERING DATA (CONTINUED)	ITEM	BORROW SOURCES	POST CONSTRUCTION DAM SURVEYS	POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	HIGH POOL RECORDS	MONITORING SYSTEMS	MODIFICATIONS

PAGE 4 OF 5	REMARKS NDI# - PA - 448	1. Diversion wall severely damaged by ice in 1968 - wall completely replaced; reservoir now drawn down in winter months to keep ice out of forebay.  2. Cold water outlet valve broke-off by ice - always open.  3. Riprap displaced in outlet channel after "Agnes" storm of June 1972.	R - Written records of maintenance by PFC personnel - routine. M - Available at PFC Office (Pleasant Gap). 1. Use Standard Manual by SCS for guidance. 2. Have developed inspection checklist.	R - No spillway discharge or outflow records. M - Available at PFC Office (Pleasant Gap).	<ol> <li>Minimum flow maintained in diversion channel by stop log mechanism near upstream end of reservoir.</li> <li>Top of stop logs in outlet works are generally kept = 4 inches above spillway weir elevation.</li> <li>Reservoir is drawn down 4 feet below spillway crest in winter as a precaution to protect against ice damage.</li> </ol>	Emergency plan recently developed by PFC for all PFC dams.	<ol> <li>Recreational facility with experimental functions (reason for the existence of the by-pass canal).</li> <li>PFC in process of developing regional notebooks which define pertinent details for all dams including M&amp;O manual, checklists, outlet works, etc.</li> </ol>
O NING ONLOG ONLO	I TEM	PRIOR ACCIDENTS OR FAILURES	MAINTENANCE: RECORDS MANUAL	OPERATION: RECORDS MANUAL	OPERATIONAL PROCEDURES	WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	MISCELLANEOUS

É

# CHECK LIST . HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

NDI ID # PA-00448

PENN DER ID #14-112
PAGE 5 OF 5

SIZE OF DRAINAGE AREA: 8.4 square miles
ELEVATION TOP NORMAL POOL: 1244 STORAGE CAPACITY: 1,010 acre-feet
ELEVATION TOP FLOOD CONTROL POOL: STORAGE CAPACITY:
ELEVATION MAXIMUM DESIGN POOL: STORAGE CAPACITY:
ELEVATION TOP DAM: 1252 STORAGE CAPACITY: 1,730 acre-feet (excludin by-pass canal
SPILLWAY DATA
CREST ELEVATION: 1244
TYPE: Rectangular concrete chute with trapezoidal-shaped weir crest.  WIDTH: 69 feet
LENGTH: 142 feet from base of weir to stilling basin.
SPILLOVER LOCATION: right abutment
NUMBER AND TYPE OF GATES:ungated
OUTLET WORKS
TYPE: Reinforcement concrete box culvert and control tower
LOCATION:near embankment center
ENTRANCE INVERTS:elevation 1211
EXIT INVERTS: elevation 1209
EMERGENCY DRAWDOWN FACILITIES: Stop logs in control tower
HYDROMETEOROLOGICAL GAGES
TYPE: None
LOCATION:
RECORDS:
MAYIMIM NON-DAMAGING DISCHARGE. Not known

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST VISUAL INSPECTION PHASE 1

PAGE 1 OF 8

COUNTY Centre	HAZARD CATAGORY High AM TEMPERATURE 45° @ 9:00 XBOX	отнекѕ	
- 488 PENNDER# 14-112	SIZE Intermediate  Der 1978 WEATHER COOl With rain  SPECTION 1235.5 M.S.L.	OWNER REPRESENTATIVES D. O'Neill (PA Fish Comm.) C. Hess (PA Fish Comm.)	
NAME OF DAM Colyer Dam	TYPE OF DAM Earth  DATE(S) INSPECTION 13 November 1978  POOL ELEVATION AT TIME OF INSPECTION  TAILWATER AT TIME OF INSPECTION	INSPECTION PERSONNEL  B. M. Mihalcin  E. J. Mannella	W. Veon J. P. Nairn

RECORDED BY J. P. Nairn

	CMENT
ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 448
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION None observed. OF EMBANKMENT AND ABUTMENT SLOPES	None observed.
VERTICAL AND HORI- ZONTAL ALIGNMENT OF THE CREST	Good.
RIPRAP FAILURES	None observed (well graded durable sandstone riprap - five feet above normal pool).
JUNCTION OF EMBANK- MENT AND ABUTMENT, SPILLWAY AND DAM	Good.

C

	NDI# PA - 448	the downstream face to poor drainage. Not			- Flow estimated at 8 GPM from drain.	
EMBANKMENT	OBSERVATIONS AND/OR REMARKS	No damp areas or irregular vegetation observed on the downstream face or at the toe. Swampy area = 100 feet downstream of the toe due to poor drainage. No considered significant.	None.	None.	Toe drains discharge into outlet channel - Flow ethe right drain and 10 GPM from the left drain.	
	ITEM	DAMP AREAS IRREGULAR VEGETATION QUSH OR DEAD PLANTS)	ANY NOTICEABLE SEEPAGE	STAFF GAGE AND RECORDER	DRAINS	

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 448
INTAKE STRUCTURE	Not observed (inundated).
OUTLET CONDUIT (CRACKING AND SPALL- ING OF CONCRETE SURFACES)	No spalling. Cracking observed within the outlet conduit in the horizontal portion approximately 10 to 15 feet downstream of the intake riser. Efflorescence and iron staining occur with the cracking.
OUTLET STRUCTURE	Interior of the vertical riser above pool level in good condition.  Exterior portion in good condition.
OUTLET CHANNEL	Riprap-lined channel from the discharge end to the end of the fish catch basin.
GATE(S) AND OPERA- TIONAL EQUIPMENT	None. Pool level regulated by stop logs.

EMERGENCY SPILLWAY OBSERVATIONS AND/OR REMARKS NDI# PA - 448	ON Concrete rectangular channel with a trapezoidal-shaped weir crest. Both end sections of the weir display numerous transverse and longitudinal cracks. Spalling observed on the downstream weir section as well. Pop-outs observed on the spillway apron.	Cut into rock.	Minor cracking and efflorescence observed on the spillway sidewalls particularly associated with the sidewall weep holes.	Partially filled with debris.	L Natural stream channel - unobstructed.	First downstream obstruction is a two-lane bridge located ~ 0.5 mile downstream.	None.
ITEM	TYPE AND CONDITION	APPROACH CHANNEL	SPILLWAY CHANNEL AND SIDEWALLS	STILLING BASIN PLUNGE POOL	DISCHARGE CHANNEL	BRIDGE AND PIERS	EMERGENCY GATES

-

	NDI# PA - 448					
SERVICE SPILLWAY	OBSERVATIONS AND/OR REMARKS	See "Outlet Works", Page 4 of 8.				
	ITEM	TYPE AND CONDITION	APPROACH CHANNEL	OUTLET STRUCTURE	DISCHARGE CHANNEL	50

PAGE . 7 OF 8 OBSERVATIONS AND/OR REMARKS INSTRUMENTATION None None None None OBSERVATION WELLS MONUMENTATION SURVEYS PIEZOMETERS ITEM OTHERS WEIRS

APPENDIX C
HYDRAULICS/HYDROLOGY

#### PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir.
- c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.
- d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

SUBJECT DAM SAFETY INSPECTION

COLYER LAKE DAM

BY DLB DATE 2-20-79 PROJ. NO. 78-617-448

CHKD. BY WJV DATE 3-6-79 SHEET NO. 1 OF 20 Environmental Specialists

## DAM STATISTICS

DAM HEIGHT " 38 FEET

(FIELD MEASURED)

MAXIMUM POOL STURAGE CAPACITY = 1730 AC-FT

(SEE SHEET 3)

NORMAL POOL STORAGE CAPACITY = 1010 AC. FT

DRAINAGE AREA ~ 8,4 sp. mi

PLANIMETERED OFF U.S.G.S
7.5 MINUTE SERIES QUADS
CENTRE HALL, BARRVILLE,
AND McALEVYS FORT, PA

## DAM CLASSIFICATION

DAM SIZE - INTERMEDIATE

(REF1, TABLE 1)

HAZARD CLASSIFICATION - HIGH

(FIELD CESERVATION

REQUIRED SDF - PMF

(REF 1, TABLE 3)

SUBJECT	LAM SAFETY INSPECTION
	COLYFE LAKE DAM

BY WJV DATE 2-20-79 PROJ. NO. 73-617-448

CHKD. BY DLR DATE 3-7-79 SHEET NO. 2 OF 20



Engineers • Geologists • Planners **Environmental Specialists** 

## HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE (L) & 7.5 MILES

[ MEASURED ALONG THE LONGEST WATERCOURSE TO THE ] LCA = 3.8 MILES

NOTE: VALUES OF L AND LCA ARE MEASURED FROM USGS 7.5 MINUTE QUADS - CENTER HALL, BARRVILLE, AND MCALEVYS FORT, PA. ALSO, ALL VARIABLES ARE DEFINED IN REFERENCE 2 IN THE SECTION ENTITLED " SNYDER SYNTHETIC UNIT HYDROGRAPH ".

C+ = 2.10 C. 2 0.50 SUPPLIED BY COE; ZONE 19, SUSQUEHANNA RIVER BASEN

tp = SNYCER'S STANDARD LAG ≈ 2.10 (L× LCA) 0.3

: to ≈ 2.10 (7.5 x 3.9) 0.3 ≈ 5.74 HRS.

# RESERVOIR SURFACE AREAS AND STORAGE VOLUMES

IN ORDER TO DEVELOP A STAGE - STORAGE RELATIONSHIP AVAILABLE SURFACE CONTOURS WERE PLANIMETERED FROM FIGURE ? "GENERAL PLAN" APPENDIY F, RESULTING IN RESERVOIR SURFACE AREAS AT 5-FOOT INTERVAL ELEVATIONS

AN ESTIMATION OF THE INCREMENTAL INCREASE IN STORAGE BETWEEN CONTOUR INTERVALS WAS COMPUTED LITILIZING THE MODIFIED PAIMOIDAL FORMULA PRESENTED BELOW:

ΔV<sub>A-0</sub> = Y (A<sub>A</sub> + A<sub>b</sub> + √(A<sub>B</sub>) (REF 14, pg 15)

RESULTS ARE TABULATED ON THE FOLLOWING PAGE.

SUBJECT DAM SAFETY INSPECTION

COLVER LAKE DAM

DATE 2-22-79 PROJ. NO. 78-617-448

CHKD. BY WJV DATE 3-6-79 SHEET NO. 3 OF 20

CONSULTANTS.

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	FROM FIG. 2. APP F	ELEVATION U.S.G.S. (FT)	SURFACE AREA (ACRES)	(ACRE-FT)	CUMULATIVE VOLUME (ACRE-FT)
	99.0	1211.0	0	0	0
	105.0	1217.0	2.6	5.2	5.2
	110.0	1222.0	13.4	36.5	41.7
	115.0	1227.0	26.2	97.2	138.9
	120.0	1232.0	40.1	164.5	303.4
	125.0	1237.0	56.9	241.3	544.7
	130.0	1242.0	70.5	317.9	862.6
NORMAL POOL -	- 132.0	1244.0	77.0	147.5	1010.1
	135.0	1247.0	86.6	245,3	1255.4
TOP OF DAM	140.0	1252.0	104.6	477.3	1732.7
	145.0	1257.0	117.5	554.9	2287.6

NOTE: THE SURFACE AREA OF COLVER LAKE AS DEPICTED ON U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE CENTRE HALL, PA., WAS MEASURED BY PLANIMETER AND FOUND TO APPROXIMATELY EQUAL 77 ACRES. SIMILARLY AT ELEVATION 132 (RELATIVE) SHOWN ON FIGURE 2, APPENDIX F, THE SURFACE AREA WAS MEASURED TO APPROXIMATELY EOUAL TTACKES. THE TOPOGRAPHIC MAP SETS THIS AREA AT ELEVATION 1244T MSL WHILE FIGURE 2 SETS IT AT ELEVATION 1225 FT MSL. SINCE CROSS-REFERENCING COULD NOT CONFIRM EITHER ELEVATION, IT WAS ARBITRARILY DECIDED TO SET MORMAL POOL AT ELEVATION 1244 FT MSL IN ACCORDANCE WITH THE U.S.G.S. FOR THE PURPOSE OF THIS ANALYSIS.

BY WJY DATE 3-6-79 PROJ. NO. 78-617-448

CHKD. BY DLB DATE 3-7-79 SHEET NO. 4 OF 20



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# PMP CALCULATIONS

- STANDARD RAINFALL INDEX = 22.2 INCHES (REF9, FIG. 2)

  (CORRESPONDING TO A DURATION OF 24HRS AND

  AN AREA OF 200 SQMI)
- GEOGRAPHIC ADJUSTMENT FACTOR ≥ 103°6 (REF 9, FIG 1) (CORRESPONDING TO A LONGITUDE OF 77°41' AND A LATITUDE OF 40° 47')
- CORRECTED RATHFALL INDEX = (22.2 IN) (1.03) = 22.9 IN
- LOCAL DRAINAGE AREA = 8.4 SQMI; ASSUME THAT DATA CORRESPONDING TO A 10 SQMI AREA IS REPRESENTATIVE OF THIS BASIN:

DURATION (HRS)	PERCEUT OF INDEX RAINFALL (0/3)
6	117.5
12	127.0
24	136.0
48	142.5
72	145.0

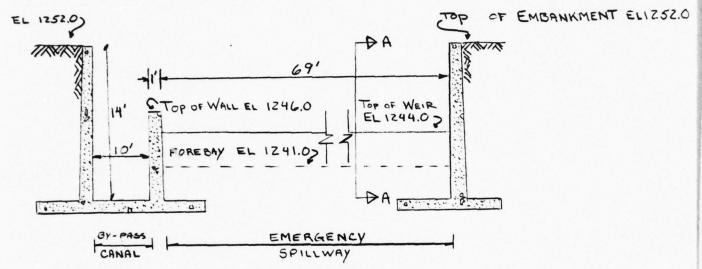
- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE, AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER AREA) CORRESPONDING TO A DA = 8.4 SEMI (10 50 MI) \$\infty\$ 0.80 (REF 4, PG 48).

SUBJECT	Da	M SAFETY	INSPECTION					
	Car	VER LAKE	DAM DAM					
BY DLB	DATE	2-22-79	PROJ. NO. 78-617-448					
CHILD BY W.TV			SHEET NO. 5 OF 20					

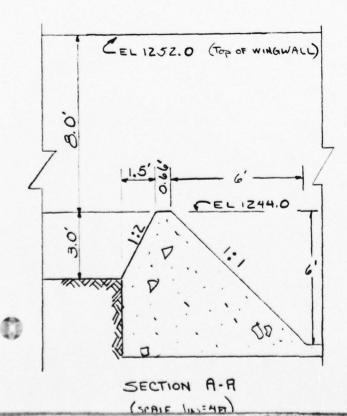


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# SPILLWAY CAPACITY AND RATING CURVE



SPILLWAY CROSS-SECTION (NOT TO SCALE)



MOTE: DIMENSIONS AND ELEVATIONS
ARE TAKEN FROM AVAILABLE DRAWING:
DATED G-4-G4 ENTITLED SINKING
CREEK DAM", PREPARED BY E.R.
MILLER (REG.ENG., STATE COLLEGE,
PA.). ALL DIMENSIONS SHOWN
HAVE BEEN ROUGHLY VERIFIED
BY FIELD MEASUREMENTS.

	-
SUBJECT DAM SAFETY INSPECTION  COLYER LAKE DAM  BY DLO DATE 2-27-79 PROJ. NO. 78-617-448  CHKD. BY WJY DATE 3-6-79 SHEET NO. 6 OF 20	CONSULTANTS, IN  Engineers • Geologists • Planners Environmental Specialists
ALTHOUGH THE SPILLWAY WEIR IS ACTUALLY TRAPEZOIDAL I ON PREVIOUS SHIET), ASSUME THAT ITS ELEVATION-DISC APPROXIMATED BY THAT FOR AN OGEE-CRESTED WES Q = CLHe <sup>3/2</sup> Where L = LENGTH OF CRES C = COEFFICIENT OF I He = HERD ON CRES	HARGE RELATIONSHIP CAN BE  TR W/ DISCHARGE DEFINED CY:  ST = 69 FT (SHEET 4)  DISCHARGE (FOR AN OGEE-WEIR)
THE DISCHARGE COEFFICIENT (C) CORRESPONDING SPILLWAY DISCHARGE CAPACITY PRIOR TO THE EDITOR TO THE EDITOR TO THE EDITOR OF THE POLLOWING PROCEDURE!	
- Ho = DESIGN HEAD = 8.0 FT P = DEPTH OF FOREBRY = 3.0 FT	(SHEET 4)
P/Ho = 3.0'/8.0' = 0.38	
" CINITIAL = 3.75 @ DESIGN HEAD	(REF 4, pg 373)
- CONSIDER THE EFFECT OF A SLOPING UPSTRE	AM FACE @ IHIZV or 26.6°
CINCLINES / CVERTICAL = 1,015 INTERPOLATE	D BETWEEN VALUES OF ANGLE OF 18.4° AND 33.7°
:. Ci = (3.75 × 1.015) = 3.81@ DESIGN HEAD	
- CONSIDER APPROACH CHANNEL LOSSES	40

2 = CHo 3/2 = (3.81X8)3/2 = 86.2 CFS/FT (FLOW PER FOOT OF WEIR LENGTH) APPROXIMATE VELOCITY OF APPROACH Va = Ho+P = 80.2 7.84 FPS APPROACH VELOCITY HEAD (ha) =  $\frac{V_a^2}{Z_g} = \frac{(7.84)^2}{2(32.2)} = 0.95$  ft

SUBJECT DAM SAFETY INSPECTION  COLYER LAKE DAM  BY DLB DATE 2-22-79 PROJ. NO. 78-617-448	CONSULTANTS. Engineers • Geologists • Plann
CHKD. BY WJV DATE $3-7-79$ SHEET NO. $7$ OF $20$ APPROACH CHANNEL FRICTION LOSS $(N_g)^2 (L) \left[ \frac{\sqrt{a} \cdot N}{1.49 \cdot R^{43}} \right]^2$	Environmental Specialists  (REF 4, Pq 379)
L = CHANNEL LENGTH = 100 FEET  N = MANNING'S COEFFICIENT = 0.04  BOTTON	(FIG 3, APPENDIXI ATED CHANNEL, COBRLE IN AND CLEAN SIDES, 7, 129 112
R = WETTED PERIMETER = (69+5+5.5) = 9.55 FT	(FIG 12, APPENDIXF
$h_{f} = (100) \left[ \frac{(7.8)(0.04)}{(1.49)(9.55)^{1/2}} \right]^{2} = 0.22 \text{ Fr}$	- 01(h) =
Assuming an entrance loss into the channel equal = $0.1 (0.95 \text{ft}) = 0.095 \text{ft} \approx 0.1 \text{ ft}$	(REF4, pg 379)
TOTAL APPROACH LOSS = (0.22+0.1) FT = 0.32 FT	
ACTUAL EFFECTIVE HEAD = DESIGN HEAD - LOSSES = (8	3.0-0.32) FT = 7.68 FT
P/He = 3.0/7.68 = 0.39	
∴ C = 3.75	(REF 4, pg 378
CINCLINED / CVENTICAL = (3.75)(1.015) = 3.81 (	NO CHANGE FROM THAT SHOWN ON SHEET 5
CONSIDER SUBMERGENCE EFFECTS	(SEE NOTE BELL

NOTE! DUE TO THE ELEVATION OF THE SPILLWAY STILLING BASIN RELATIVE TO THE CREST OF THE WEIR (AH = 37 FT)

IT CAN BE ASSUMED THAT THE WEIR WILL NOT BE SUBMERGED WOER LESS THAN (AT LEAST) DESIGN TO SLIGHTLY GREATER THAN TECTION HEADS

SUBJ	ECT	DAM	SAFETY IN	SPECTION	1	
			VER LAKE			
RY	DLB		7-23-79		18-617-448	



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BA	DATE	6-63-17	PROJ. NO. 78-611-478
CHKD. BY WJV	DATE	3-6-79	SHEET NO8 OF25

G-CLH %	(crs)			220	040	11 70	1870	0192	3 550	0644	0295	6370	8050	9390
I	(E) (E)			0.1	0.2	2.9	3.9	4.8	5.8	6.7	7.7	8.6	9.6	10.5
Į	(H)			0.01	0.04	80'0	0.13	0.17	0.23	0.27	0.32	0.36	0.40	0,46
s	(4.0			1000	.0003	1000.	0100.	.0013	1100.	9100.	2200.	42 00°	9200.	6200'
(0.7)NG	(F)		ı	100.	500	410.	520.	.039	.056	.075	560.	811.	141.	109
	_	9	1	8.0	1.86	2.47	10.4	5.03	6.0	6.95	7.84	8.71	9.54	10.42
H. P	(H)		~	1	Ŋ	•	7	0	5	01	=	21	13	±_
9. C. H 16	(c15/FT)	The state of the s	1	3.2	9.3	17.8	1.82	40.2	54.1	69.5	86.2	104.5	124.0	145.9
ರ			1	3.18	3.30	3,43	3.51	3.60	3.68	3.75	3.81	3.87	3.92	4.00
c./c.	(	•	ı	0.835	0.865	0.400	0.920	0.945	0.965	0.485	1.000	1.015	1.030	1.050 1.00
°,			ı	3.8	3.81					3.81	3.81	3.81	3.81	3.81
He/Ho			ı	0.13	0.25	0.36	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1.38
He.	Ê		<b>*</b> 0	-	2	~	7	5	9	~	80	0	0	=
	He/Ho C. C./C. C. G. C. HerP 1/2 (0.7) S H.	C. C./C. C. q.: C. HerP Va (0.17)ha S HL H (cis/H) (H) (rPs) (rT) (CT) (FT)	He/He C. C. G. C. G. C. HerP Va (6.7)ha S H. H (c15/H) (r1) (r10) (r1) (r1) (r1) (r1) (r1)	He/He C. C./C. C. q.: C.H. HerP Va (6.1)NL S H. H (c15/H) (H) (GRS) (1T) ((H) (H) (H)	He/He C. C./C. C. q. c, He of Va (6.1)Nu. S H. H (c15/FT) (FT) (FT) (FT) (FT) (FT) (FT) (FT) (	He/He C. C./C. C. qc.He <sup>3/k</sup> HerP Va (0.1)Nu. S H. H (crs/fr) (rr) (rrs) (rr) (rr) (rr) (rr) (rr) (	He/He C. C./C. C. q.: c, He P Va (0.1)NL S H. H. H. H. H. H. H. H. P Va (0.1)NL S H.	He/He C. C. G. G. He'R Va G.Dha S H. H G. G. G. M. M. Gres G.T. G. M. G.T. G. M. M. G.T. M.	He/He C. C. C. G. C. HerP Va G.Dha S H. H. H. H. H. Va G.Dha S. C. H.	He/He C. C./C. C. q.: C.He <sup>3</sup> /He He P Va (0.1)Na S H. H. H (013) (113)	He/He C. C. C. Q.: C.He <sup>3</sup> /He He P VA (6.1)Ma. S H. H. H. H. H. M. (6.1)Ma. S H. H. H. H. H. M. (6.1)Ma. S H. H. H. H. H. H. H. M. (6.1)Ma. S H. H. H. H. H. H. H. H. M. (6.1)Ma. S H.	He/He C. C./C. C. qC.He <sup>2</sup> /He P Va (0.1)Na S H. H. H. H. P Va (0.1)Na (17) (17) (17) (17) (17) (17) (17) (17)	He/He C. C. C. C. Q. C. HerP Va (G.1)ha S H. H. H. H. H. P Va (G.1)ha S. S H. H. H. H. P Va (G.1)ha S.	He/He C. C/C. C. q:-C,He/He/P Va Grish, S H. H. H. H. Crish) (rr) (rr) (rr) (rr) (rr) (rr) (rr) (r

(RLF4, FIG 251, 76 379) SEE SHEET S INCLINATION BY MULTIPLYING THE Cife = COMPICTION TO Co : 3.81 FOR HEADS OTHER THAN DESIGN (HE: 8.01T), (Ref 4, Pg 378) NOTE: CO HAS BEEN COFFEETED FOR UPSTREAM SLOPE By 1.015 VELCCITY HEAD (Na) = Zq VALUE FOR C = 3.75 (REF.4) FIG 249, P9316) 9 KHETP) (REF 4, PG 379) ( VAN / HEAD )

IS ESTABLISHED AT SPILLWAY CREST ELEVATION 1244.0 Ho-H He :0

where N=0.04

0.1 (h, ) + 100 (S)

D

SUBJECT DAM SAFETY INSPECTION COLYER LAKE DAM BY DLB DATE 2-23-79 PROJ. NO. 78-617-448

CHKD. BY WJV DATE 3-7-79 SHEET NO. 9 OF 20



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# OUTLET CONDUIT CAPACITY

REFER TO FIGURE ? , APPENDIX F FOR PLAN AND CROSS-SECTION

TYPE OF CONDUIT - 4'by 4' REINFORCED CONCRETE BOX CONDUIT LENGTH - 215.5' (INLET TO OUTLET) INLET INVERT ELEVATION - 1211. OFT OUTLET INVERT ELEVATION - 1209.ZFT

ASSUME FULL-BARREL FLOW WITH OUTLET CONTROL AND ALL STOP-LOGS REMOVED FROM TOWER

OUTLET CONTROL DISCHARGES ARE ESPECIALLY DEPENDENT ON THILWATER LEVEL, ALONG WITH ALL OTHER CHARACTERISTICS OF THE CULVERT BARREL. OUTLET CONTROL CAN OCCUR IF H > 0.755 (H = HEADWATER DEPTH, D = CULVERT DEPTH) WITH DISCHARGE DEFINED BY ITS RELATIONSHIP TO HEADWATER AS SHOWN IN THE EQUATION BELOW.

where HW = WATER SURFACE ELEVATION @ WLET (FT)

Ke - ENTRANCE LOSS COEFFICIENT

N = MANNING'S ROUGHNESS COEFFICIENT

R = HYDRAULIC RADIUS (FT) = WETED DERIMETER

L = CULVERT LENGTH (FT)

TW " WATER SURFACE ELEVATION @ OUTLET (FT)

= GRAVITATIONAL CONSTANT (32 FT/SEC?)

- CROSS-SECTIONAL AREA OF CULVERT (FT2)

= SLOPE OF CULVERT (FT/FT)

INFORMATION OBTAINED FROM : "HYDRAULIC CHARTS FOR THE SELECTION OF HIGHWAY CULVERTS, U.S. DEPT OF COMMERCE, BUREAU OF PUBLIC ROADS

DAM SAFETY INSPECTION COLVER LAKE DAM

CHKD. BY WJV DATE 3-7-79 SHEET NO. 10 OF 20

BY DLB



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DETERMINE THE CAPACITY OF THE CULVERT UNDER MAXIMUM HEADWATER CONDITIONS, THAT IS; HW = EL 1252.0 FT (TOP OF DAM)

ASSUME TAILWATER JUST SUBMERGES THE OUTLET (TW = EL 1213.2FT)

NEGLECT HEAD LOSSES DUE TO THE TRASHRACK

Ke = 0.4 (WINGWALL @ 30° TO 75° TO CULVERT)

SEE NOTE AT THE

M = 0.011 (AVERAGE VALUE FOR CONCRETE PIPE OR CAST IN- PLACE CONDUIT (REF 4, P9 471)

A = ILEFTZ S = (1211.0-1209.2)/(215.5) = 0.008 R = 16 FT = 1 FT

HW-TW=H=(1252.0-1213.2) FT = 38.8FT

38.8 FT = [1+0.4 + 29(0.011) (2155) | Q2 | (215.5)(0.008) 38.8+1.7 (1.4+0.76)

QMAX = 560 CPS (SEE NOTE BELOW)

NOTE 8 THE MAXIMUM DISCHARGE CAPACITY OF THE OUTLET CONDUIT REPRESENTS LESS THAN 8% OF THE TOTAL COMBINED CAPACITIES OF THE SPILLWAY AND ADJACENT DIVERSION CANA (SEE SHEET 19). FURTHERMORE, THERE IS MUCH DOUBT AS TO WHETHER THE MAXIMUM CAPACITY COULD BE ACHIEVED IN AN EMERGENCY SITUATION DUE TO THE PRESENT OPERATING MODE THAT INCLUDES MANUALLY INSTALLED STOP-LOGS WHICH CONTROL DISCHARGES FROM THE RISER LOCATED ABOUT MIDWAY ALONG THE CONDUIT. THEREFORE, THE ADDITIONAL FLOW CAPACITY THROUGH THIS LOW LEVEL OUTLET WILL BE IGNORED.

SUBJECT	NAM SAFETY INSPECTION

WJV DATE 3-1-79

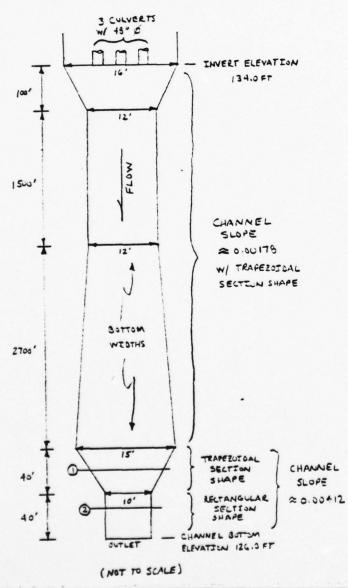
CHKD. BY DLB DATE 3-8-79 SHEET NO. 11 OF 26



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# BY-PASS CANAL

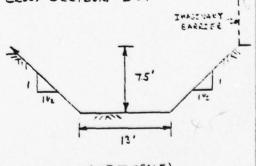
- A 4400 FOOT LONG MAN-MADE CHANNEL DIVERTS A PORTION OF THE RESERVOIR INFLOWS AT A POINT ABOUT 300 FT UPSTREAM FROM THE RESERVOIR (AT NORMAL POOL ELEVATION).
- DEFINITION SKETCH OF CANAL (AS DETAINED FROM OCIGINAL DESIGN CALCULATIONS CONTAINED IN PENN DER FILES):



- CANAL IS COMPOSED MOSTLY DE
  TRAPEZOTUAL SECTIONS W/
  SIDE SLOPES OF 1/2 H to 1V
  AND A REPRESENTATIVE DEPTH
  OF ABOUT 7.5 FT (APPENDIX F,
  FIGURE 12)
- THEREFORE , A REPLESENTATIVE

  CROSS SECTION IS:

  RESERVOTE



( NOT TO SCALE )

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CHKD. BY DLB DATE 3-8-79 SHEET NO. 12 OF 20

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- ASSUME THAT POTEN IAL RESERVOIR INFLOWS ARE DIVIDED 50-50 AT THE CONFLUENCE OF THE NATURAL STREAM AND THE BY-PASS CANAL . HOWEVER, DUE TO THE ROAD EMBANKMENT THAT CROSSES BOTH CHANNELS (APPENDIX F, FIGURE 2) THE ACTUAL INFLOWS INTO THE RESERVOIR AND DY-PASS CANAL ARE CONTROLLED AT THESE ROAD CRUSSINGS BY A 10' BY 30' BOX CULVERT AND BY 3-48" DIAMETER CMP COLVERTS , RESPECTIVELY. BASED "ROUGHLY" ON CONVEYANCE:

K = 1.44 A R212

(REF 7, PG 128)

WHERE A = AREA OF OPENING IN FT ; R - PERIMETER OF OPENING ; AND A = 0.035 FOR THE LARGE BOX CULVERT, AND A 0.024 FOR THE CMP CULVERTS (FIELD INSPECTION AND REF 7, PGS 110 AND 112)

(Kex colvert = 20830; Kemp colverts = 2260) THE COX CULVERT CAN PASS ABOUT 13 TIMES AS MUCH FLOW AS THE CMP CULVERTS. FURTHER, ASSUME THAT THIS RATIO APPRIXEMENTE. HOLDS WHEN CONSIDERING A VOLUME RELATIONSHIP KATHER THAN A FLOW RELATION SHIP BETWEEN THE RESERVOER AND THE BY-PASS CANAL. THEREFORE, THE POTENTIAL RESERVOIR STORAGE SHOULD DECESASE BY 13 A-F FOR EVERY 14-F DECESASE IN THE POTENTIAL BY-PASS CANAL STORAGE.

APPROXIMATE MAXIMUM BY-PASS CANAL STORAGE: (EASE) ON THE AVERAGE SECTILITY

V = (X-SECTIONAL AREA ) × (LENGTH OF CANAL)

V= [(13'x7.5')+2(1.5×7.5')(75)/2] × (4380')/(435~ €

V = 13.3 A.F

B WJV DATE 3-6-79 PROJ. NO. 79-6/7- 449

CHKD. BY DLB DATE 3-8-79 SHEET NO. 13 OF 20



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- BY-PASS CANAL : DEPTH-STORAGE RELATIONSHIP

DEPTH (FT)	AREA (Ft²)	VOLUME (A-F)
0	0	0
2	32.0	3.2
3	52.5	5.3
4	76.0	7.6
5	102.5	10.3
6	132.0	13.3
7	164.5	16.5
7.5	131.9	13.3

- Assume That THE CRITICAL SECTION @ THE CANAL OUTLET CONTROLS OUTFLOWS (DUE TO THE CHANNEL CONSTRICTION AND SE THE ACRLIT CHANGE FROM A SUCCRITICAL SLOPE TO A SUPERCRITICAL SLOPE), SINCE THE FLOWS AT THE REPRESENTATIVE SECTION COMPUTED VIA THE MANNING EQUATION (REF 7, PG 99) WERE.

LARGER THAN THOSE THAT COULD BE ACCOMMODATED AT THE CRITICAL SECTION. FOR EXAMPLE: THE MANNING FLOW @ THE REPRESENTATIVE SECTION CORRESPONDING TO A 3' DEPTH IS GIVEN BY

WHERE N = 0.030 (EARTH COTTOM W/ RUBBLE SIDES; REF 7, PO 112);

A = (13×3) + [(1.5×3)(3)] = 52.5 FT ; R = 13+2√(1.5×3)+(3)T = 2.5

S = 134 FT - 126 FT = 0.00193

: Q = 129 CFS ,

WHILE THE OUTFLOW @ THE CRITICAL SECTION CORRESPONDING TO A 3FT DEPTH IN THE UPSTREAM REPRESENTATIVE SECTION IS



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ABOUT Q = 160 CFS (SEE COMPUTATION EQUATIONS RELOW AND SHEET 16)

- CRITICAL SECTION FLOWS ARE BASED ON AN ENERGY BALANCE BETWEEN SECTIONS @ O AND @ AS LOCATED ON SEETCH ON SHEET 11.

APPLYING THE ENERGY EQUATION (KEF 7, P640):

WHERE Y = DEPTH OF FLOW @ SECTION D , T, = ESTIMATED VELOCITY @ 0 , AND Z, = CHANNEL ELEVATION & D; 4, = DEATH OF FLOW @ SECTION @ (CRITICAL DEPTH), UZ = VELOCITY @ ( CRITICAL VELOCITY ), ZZ = CHANNEL ELEVATION @ @ , AND NL = HEAD LOSS BETWEEN @ AND @ = Loss DUE TO CONTRACTION ONLY ≈ 0.2 40 (REF 13, PG 185) SINCE he = FRICTION LOUS IS NEGLIGIBLE.

STACE Z,-Z2 = 0 >

ALSO, SINCE THE CRITICAL SECTION (SECTION @) IS RECTANGULAR (SEE SKETCHES ON SHEETS 11 AND 15):

$$\gamma_2 = \gamma_L = \sqrt[3]{9^2/9}$$
 (REF 13, PG 143)

WHERE q = 2/BOTTOM WIDTH = 2/13FT

- VELOCITIES @ SECTION D WILL BE ESTIMATED BY MANNING'S EQUATION W/ REPRESENTATIVE SECTION GEOMETRY, na 0.030 AND SA 0.00193 (AS GIVEN ON SHEET 13):

DATE 3-6-79 PROJ. NO. \_\_ 73-617-449 VLW

CHKO. BY DLB DATE 3-8-79 SHEET NO. 15 OF 20

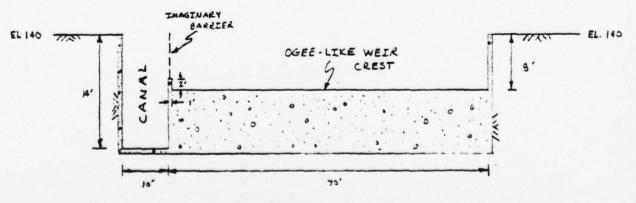


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	FLOW DEPTH	A	R:13	* 5,	V./29
	(FT)	(FT 2)	(FT)	(FPS)	(FT)
	0	0	0	0	0
	2	32.5	1.36	2.59	0.13
	3	52.5	1.69	3.59	0.20
	4	76.0	1.97	4.17	3.27
	5	102.5	2.22	4.72	0.35
	6	132.0	2.44	5.13	0.42
TOP	7	164.5	2.65	5.63	3.49
OF	- 7.5	131.9	2.74	5.82	0.53
CANA	9	234.8	3.13	6.65	0.69
	10	275.3	3.37	. 7.16	0.80
	11	315.3	3.59	7.63	0.90
	12	356.8	3.80	8.07	1.01
	13	399.8	4.00	8.50	1.12
	14	444.3	4.19	8.90	1.23
	15	490.3	4.38	9.31	1.34
	10	537.8	4.55	9.67	1.45
	17 .	556.8	4.72	10.03	1.56

+ T = Q/A FEOM CONTINUITY

ALSO DEFINITION SKETCH OF SPILLWAY CREST SECTION : (SEESHEET 4)



(NOT TO SCALE)

DATE 3-6-79 VLW

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CHKD. BY DLB DATE 3-8-79 SHEET NO. 16 OF 20



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FLOW VS DEPTH RELATIONSHIP FOR BY-PASS CANAL (BAJED ON TRIAL & ERROR SOLUTION OF EQUATIONS ON SHEET 14)

Y, (FT)	(Fr)	<b>Q</b> (cfs)	© Y2 (FT)	A <sub>2</sub> (er)	(FT)	0.2 ( 전 = 전 ) (Fr)	(FT)
6	0	0	0	0	0	0	0
2	0./3	90	1.36	13.6	0,69	0.11	2.15
3	0.20	160	2.00	20.0	1.00	0.16	3.16
4	0.27	250	2.69	26.9	1.34	0.21	4.24
5	0.35	360	3.43	34.3	1.71	0.27	5.41
6	0.42	470	4.09	40.9	2.05	0.33	6.47
7	0.49	580	4.71	47.1	2.35	0.37	7.43
0 7.5	0.53	650	5.09	50.8	2.54	0.40	9.02
B{ 9	0.69	360	6.12	61.2	3.06	0.47	9.65
10	0.80	1020	6.36	68.6	3.43	0.53	10.92
11	0.90	1190	7.56	75.6	3.75	0.53	11.92
12	1.01	1340	8.23	92.3	4.12	0.62	12.77
13	1.12	1520	3.95	99.5	4.48	0.67	14.10
14	1.23	1700	9.65	96.5	4.92	0.72	15.19
15	1.34	1900	10.39	103.9	5.19	0.77	1 35
10	1.45	2100	11.11	111.1	5.55	0.52	17.48
17	1.56	2300	11.80	113.0	5.90	0.97	19.57

- @ FRIM SHEET 15
- & FINAL ASSUMED Q
- & FROM EQUATION ON SHEET 14 : Y2= Yc = \$ 92/9
- DA = ID Y (RECTANGULAR SECTION AS ON SKETCH ON SHEET 15)
- 1 v, = Q/Az
- @ CHECK ON THE ASSUMPTIONS
- @ Assume THAT THE CONSTRUCTED CHANNEL SECTION CHOKES BETWEEN THESE DEPTHS SUCH THAT THE BY-PASS CANAL WSEL! ARE DICTATED BY THE RESERVOIR ( Y. = 9 FT => EL 1247 (MSL) IN BOTH THE RESERVOIR AND CANAL). CRITICAL CONTROL THEN MOVES TO CUTLET. Y = 10 FT => EL 1248 , Y = 11FT => EL 1244 , etc (SEE SHEET 19 FOR ET.PAS: Q VS RES.EL.)

WJV DATE 3-6-79 PROJ. NO. 79-617-449

CHKD. BY DLB DATE 3-8-79 SHEET NO. 17 OF 20



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### TOTAL RESERVOIR STORAGE-ELEVATION RELATIONSHIP

TOTAL . STORAGE = RESERVOIR STORAGE + BY-PASS CANAL STORAGE

ASSUME AVAILABLE RESERVOIR STORAGE DECREASES BY 13 A-F AS THE BY - PASS CANAL DECREASES BY | A-F (SHEET 12)

ASSUMED USGS ELEVATION (FT)	RELATIVE ELEVATION FROM DRAWINGS (FT)	PESERVOIR STORAGE (A-F)	SY-PASS STORAGE (A-F)	CANAL DEPTH (FT)	TOTAL STORAGE
1244	132	1010.1	0	0	1010.1
1245	133	* 1091.9	6.3	3.4	1093.2
1246	134	1173.6	12.6	5.3	1196.2
1247	135	1255.4	13.3	7.5 +	1273.7
1249	136	1350.9	18.3	tt.	1369.2
1249	137	1446.3	183	"	1464.6
1250	139	1 /541.8	13.3	t.	152.1
1251	139	* 1637.2	18.3	11	1655.5
1252	140	1732.7	13.3	u	1751.0
1253	141	* 1343.7	19.3	11	1962.0
1254	142	1954.7	13.3	u	1173.0
1255	143	2065.6	113	16	2083.9
1250	144	2176.6	19.3	и	2194.9
1257	145	2287.6	19.3	ų	2305.9

<sup>\*</sup> INTERPOLATED

- O RESERVOIR VOLUMES FROM SHEET 3
- & BY-PASS CANAL STORAGE VALUES BASED ON A VOLUME OF RESERVOIR AND INTERPOLATED FROM SHEET 13

WJV DATE 3-6-79 PROJ. NO. 79-617-448

CHKD. BY DLB DATE 3-8-79 SHEET NO. 19 OF 20



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## DAM EMBANEMENT RATING CURVE

ASSUME THAT THE EMBANKMENT ACTS LIKE A PRIAC-CRESTED WEIR WHEN OVERTOPPED. DISCHARGES ARE DEFINED RY

Q = CLH 3/2

WHERE Q: DISCHARGE IN CFS , L= EMBANKMENT LENGTH \$ 700 FT (FIELD MEASURES), H= DEATH OF WATER OVER DAM IN FT , AND C = DISCHARGE COEFFICIENT = f ( 4/2) W/ L= BREADTH OF CREST = 15 FT (FIELD MEASURED)

USGS (FT)	RELATIVE (FT)	(FT)	H/R (FT/FT)	* C	Q (cr))
1252	140	٥	-	-	0
1253	141	1	0.07	3.03	2120
1254	142	2	0.13	3.05	6040
1255	143	3	0.20	3.07	11170

<sup>\*</sup> VALUES OBTAINED FROM REF 12, PG 46.

BY WJV DATE 3-6-79 PROJ. NO. 73-617-443

CHKO. BY DLR DATE 3-8-79 SHEET NO. 19 OF 20



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# TOTAL RESERVOIR DISCHARGE RATING CURVE

TOTAL DISCHARGE = SPILLWAY Q + BY-PASS CANAL Q + EMBANKMENT Q

ASSUME THAT THE CONSTRICTED CHANNEL LENGTH NEAR THE MOUTH OF THE BY-PASS CANAL BECOMES CHOKED BY THE TIME THE RESERVOIR REACHES EL. 135.0 SO THAT THE BY-PASS CANAL BECOMES PART OF THE RECERVOIR WITH WATER SURFACE DICTATED BY THE RESERVOIR. THE CRITICAL CONTROL SECTION WILL THEN BECOME THE OUTFLOW SECTION Q THE TOP OF THE SPILLWAY CHUTE

ELEV	ATTON	SPILLWAY	By-PASS CANAL	EMBANKMENT	TOTAL
USGS	RELATIVE	a	a	Q	Q
(FT)	(FT)	(CFS)	(CFS)	(CF5)	(CFS)
1244	132	0	0	-	0
1245	133	220	200	-	425
1246	134	640	450	-	1090
12469	134.9	* 1120	650	-	1770
1217	135	1170	960	-	2030
1248	136	1870	1020	-	2590
1249	137	137 <b>2610</b> 1190 139 3550 1340		-	3790
1250	139			-	1390
1251	139	4490	1520		6010
1252	140	5620	1700	0	7320
1253	141	6730	1900	2120	10750
1254	142	8050	2100	6040	13190
1255	143	9390	2300	11170	22960
			1		

<sup>\*</sup> INTERPOLATED

DATE \_\_ 3-14-79 VZW

PROJ. NO. \_\_79-617- 448

CHKD. BY DLB DATE 3-15-79 SHEET NO. 20 OF 20



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# SENSITIVITY OF WEIR COEFFICIENTS

THE TRAPEZOIDAL-SHAPED SPILLWAY WEIR WAS ASSUMED TO BE APPROXIMATED BY AN OCEE-SHAPED WEIR FOR THE PURPOSE OF COMPUTING APPROPRIATE WEIR ("C") COEFFICIENTS.

However: IF THE INITIAL "C" COEFFICIENT @ DESIGN HEAD WAS ASSUMED TO BE 3.33 (ACCORDING TO THE FRANCES FORMULA FOR SHARP-CRESTED WEIRS: REF 9, PS. 25) RATHER THAN THE ACTUAL ASSUMED VALUE OF 3.75 (SHEET 6), THE SPILLWAY CAPACITY WOULD BE ABOUT : CORRECTED FOR APPROACH LOSSES AS

> Q = (3.33 × 1.015) (69 FT) (7.8 FT) I CORRECTION FOR SLOPING US FACE FROM SHEET 6

Q = 5080 CFS

TOTAL DISCHARGE SYSTEM CAPACITY BELOW THE TOP OF DAM ELEVATION QT = 5090 CFS + 1700 CFS (FROM THE BY-PASS CANAL WOULD BE: @ EL 1252 , SHEET 19). QT = 6790 CFS

(THE ACTUAL ASSUMED DISCHARGE SYSTEM CAPACITY @ EL 1252 IS ABOUT QT = 7320 CFS => 8% INCREASE OVER ABOVE VALUE) (SHEET 14)

IF QT = 6780 CFS \$ COLYER LAKE DAM COULD HANDLE MORE THAN 70 PER CENT OF THE PMF ( SINCE THE RESERVOIR INFLOW FOR 0.7 PMF = 6906 ; SUMMARY INPUT/ OUTPUT SHEETS, SHEET R).

FOR QT = 7320 CFS & COLYER LAKE DAM CAN HANDLE 400UT 77 PERCENT OF THE PMF AS STATED IN SECT. 5.5.

THE ABOVE COMPARISON INDICATES THAT EITHER "C"-COEFFECTENT ASSUMPTION WOULD LEAD TO AGOUT THE SAME RESULTS. HOWEVER, CHATTAL 375 IS FELT TO BE MORE REPRESENTATIVE OF ALTUAL CONDITIONS BASED ON REF 5, SECT 5.

SUBJECT	DAM	SAFETY I	NSPECTI	'AA'
	C	DLYER LAK	EDAM	
VEW_Y	DATE	3-7-79	PROJ. NO.	73-617-448

PROJ. NO.

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CHKD. BY DLI3 3-8-79 DATE SHEET NO.



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RTIMP 0.00

ALSMX 0.00

# SHEETS SUMMARY INPUT/OUTPUT

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•			300	SPEC	JOB SPECIFICATION	NC.			
	NHR	MAIN	IDAY	IHE	ININ	METRC	IPLT	IPRT NST	NST
	•	15	•	•	•	9	0	9	
			JOPER	NWT	LRUPT TRACE	TRACE			
			2	0	0	•			

20

MULTI-PLAN ANALYSES TO BE PENFORMED NPLAN= 1 NNTIU= 5 LNTIO= 1.00 .70 .80 .90 1.00 .50 RTIOS= \*\*\*\*\*\*\*\*\* SUB-AREA RUNDIF COMPUTATION \*\*\*\*\*\*\*\*\* \*\*\*\*\*\*\*\*\* \*\*\*\*\*\*\*\*\*

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SUBJECT			AFFTY FR LAK	INSPECTION -		
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SUBJECT_					FR	TY I		PECT M	To	Al		_				-					1		
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CHKD. BY	DLE	3_	DATE		3-8	-79	Si	HEET	NO			_ <	)F_	D	)	-		Environ	men	tal	Spe	ogis	sts • Planner llists
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	135.00	2030.00	1369. 14	136. 1	ELEVL C	COUD EXPD	HOURS	• •	243.	240.93		IURS				166.96	3630.	53	•		7.53	3371.	4159.
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0	132.00	10750.00	Y= 1010.	N= 132.	# REIATTVE EL. 132.0 FT	≈ 156: EL 1244.0 FI (MSL)	PEAK OF					PEAK O	_	<b>~</b>	15			PFAK OL					_
	STAGE #	FLUW	CAPACITY=	ELEVATION=	# REIATTVE	≈ 136± €							RESFLAUTR	OUTFLOW	HYDREGENAPHS								

A Comment of the Comm

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SUBJECT DAM SAFETY INSPECTION COLYER LAKE DAM

DATE 3-7-79

CHKD. BY DLB DATE 3-8-79

VLW

SHEET NO. D OF D

CONSULTANTS, INC

Engineers • Geologists • Planners Environmental Specialists

# SUMMARY OF DAM SAFETY ANALYSIS

	TIME OF FALLUKE HOURS	00000
10P UF DAM 140.00 1751. 7320.	TIME OF MAX UUTFLOW HOUKS	46.25 45.75 45.50 45.50
	DURATION UVER TOP HOURS	0.00 1.50 2.35 5.35
SPILLWAY CREST 132.00 1010.	MAXIMUM OUTFLOW CFS	4629. 6549. 7606. 8671.
INITIAL VALUE 132,00 1010.	MAXIMUM STURAGE AC-FT	1537. 1695. 1795.
	MAXIMUM DEPTH OVER DAM	00000
ELEVATION STURAGE OUTFLUM	MAXIMUM RESERVOIR W.S.ELEV	137.76 139.41 140.08 140.39
	RATIO OF PMF	2.000.1

SUAPED WETR CPECT. HOWEVER, EVEN IF LOWER WETR COEFFICIENTS TRAPEZOTUAL - SHAPED SPILLWAY OGEE-AN THE ASSUMPTION THAT WERE USED, THE ACOVE RECUITS WOOLD BE ABOUT THE SAME COMPUTING FLOWS OVER EXISTING \* THESE OUTFLOWS ARE DEPENDENT ON APPROXT MATED BY THE DISCHARGES OVER WETL CAN BE SHEFT (SFE THE

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- 15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX D
PHOTOGRAPHS

Overview of Colyer Lake Dam as seen from the right abutment. PHOTOGRAPH 1 Close-up view of the sandstone riprap on the upstream face of the dam. PHOTOGRAPH 2

View of the reservoir and surrounding slopes at Colyer Lake Dam. PHOTOGRAPH 3 Close-up view of the concrete vertical riser portion of the outlet works. Note the stop logs laying to the left of the riser. PHOTOGRAPH 4

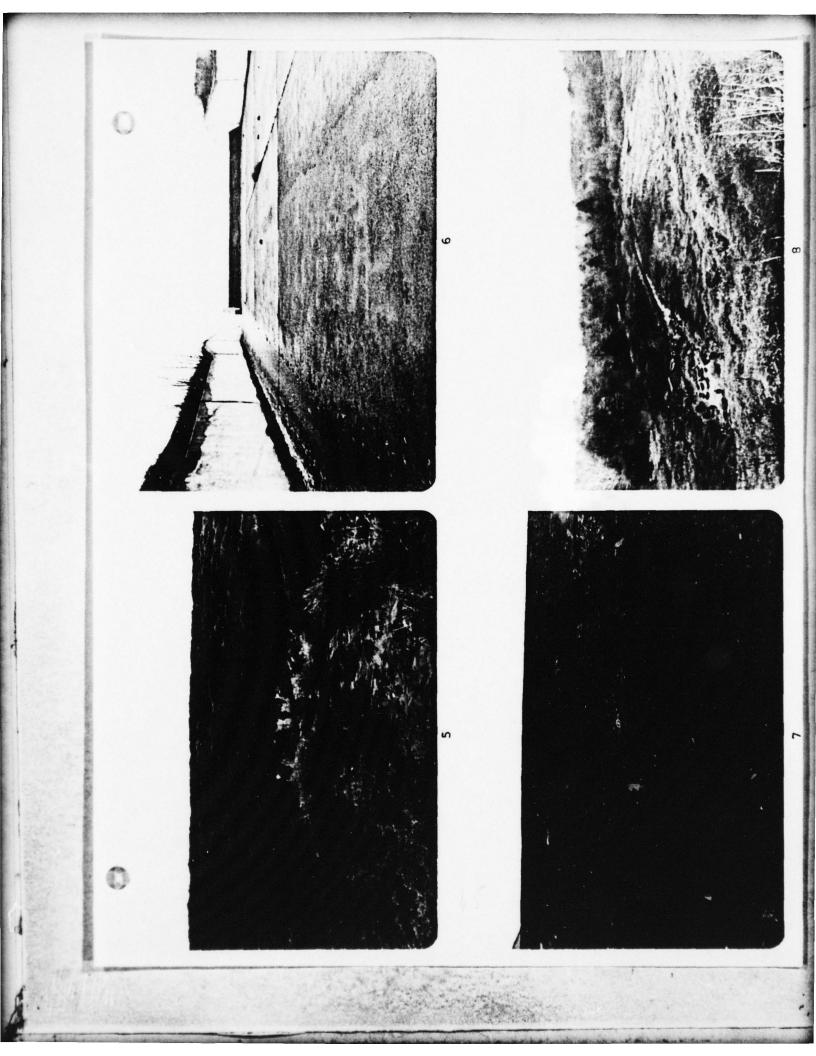


View of the discharge end of the outlet works and the downstream face of the dam. PHOTOGRAPH 5

View of the spillway as seen from the plunge pool area. Note that the spillway consists of combined rectangular and trapezoidal-shaped weir sections. PHOTOGRAPH 6

Close-up view of cracking and spalling on the trapezoidal-shaped weir portion of the spillway. PHOTOGRAPH 7

View looking downstream from the crest of the dam. PHOTOGRAPH 8



PHOTOGRAPH 9

View of a bifurcation in the stream, upstream of Colyer Lake where flow can either be directed into the reservoir (left channel) or into the by-pass canal (right channel).

PHOTOGRAPH 10

View of a bridge over Sinking Creek located approximately 2,500 feet downstream of the dam. The bridge represents the first downstream obstruction. Note the home in the left center portion of the photo-

graph.





APPENDIX E GEOLOGY

## **GEOLOGY**

Colyer Lake is located approximately 8.5 miles east of State College in the Appalachian Mountain section of the Valley and Ridge Province of central Pennsylvania. The Appalachian Mountain section is characterized by interbedded hard and soft sedimentary rocks that have been strongly folded into tight, high amplitude anticlines and synclines by compressional forces from the southeast. The folded structures trend in a southwest-northeast direction and plunge in both directions along the axial strike. The Bear Meadows anticline, plunging to the southwest, passes through a portion of Colyer Lake.

The surface sedimentary rocks exposed in the general area range in age from the Lower Silurian (youngest) to the Lower Ordovician (oldest). Underlying the dam and most of the reservoir area are sedimentary rocks of the Reedsville Formation (Ordovician). The Reedsville Formation consists almost entirely of shale with thin silty and sandy interbeds. An exposure of the upper portion of the Reedsville Formation on the right abutment consists chiefly of brown, greenish, and black clayey to sandy shale with thin limestone beds or concretions. The shales gradually grade into a sandstone of the Bald Eagle Formation which occurs above the dam in the surrounding hillsides.

Test borings at the dam site reveal that in the valley rock lies at a depth of about 10 feet below the ground

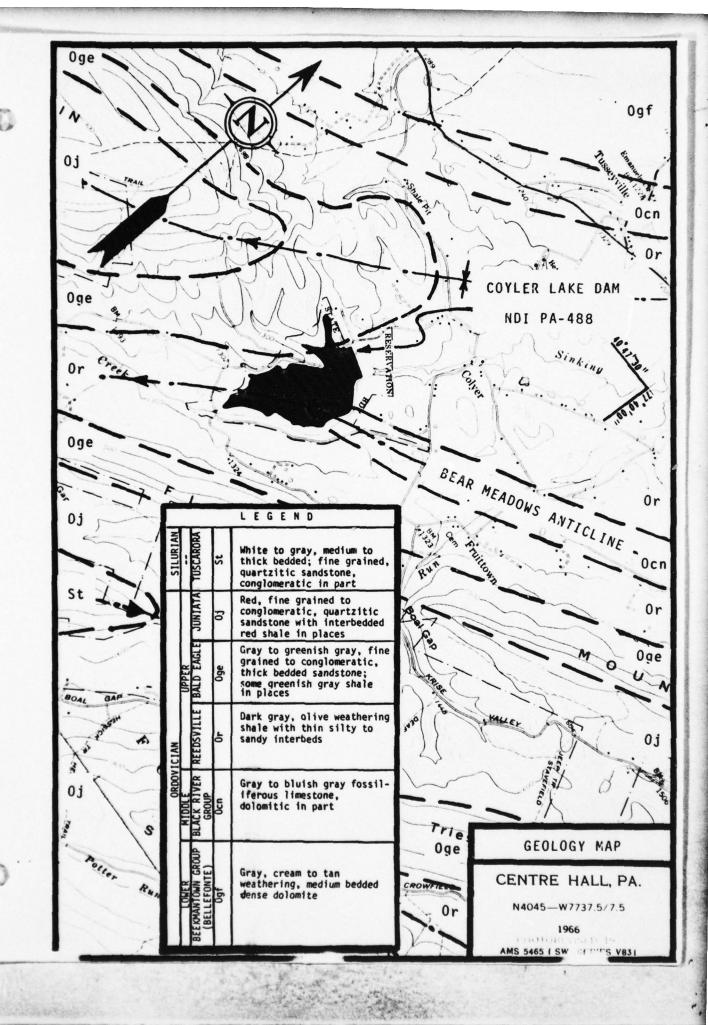
surface. The underlying rock consists essentially of shale with the uppermost 5 to 10 feet being broken. The degree of brokenness decreases with depth. The alluvial and residual soils underlying the dam and the reservoir area consist of a mantle of impervious clay.<sup>3</sup>

Water well data indicates that the transmissibility of the Reedsville Formation is low, particularly in the lower portions of the formation.  $^{2}$ 

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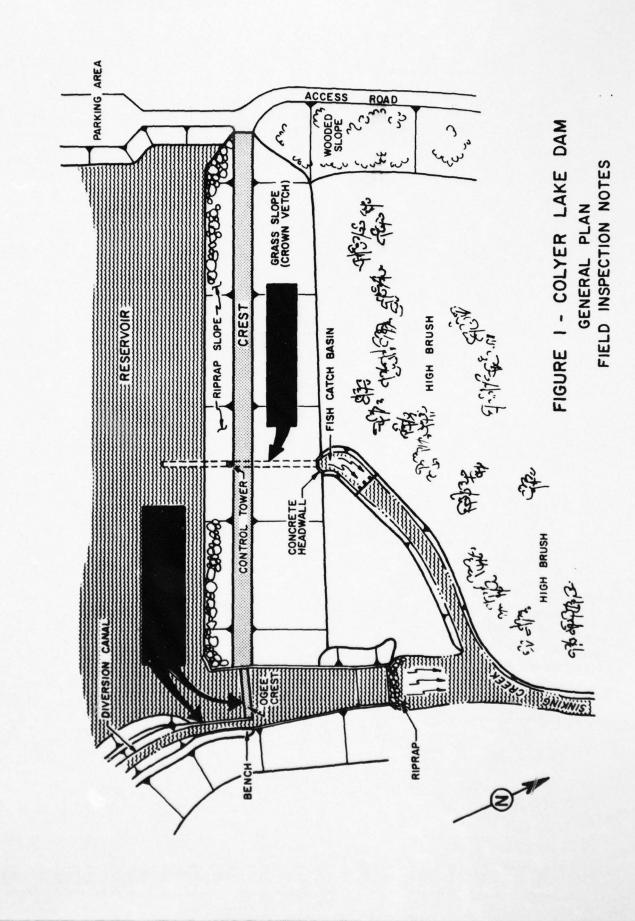
<sup>&</sup>lt;sup>3</sup>Miller, Edward R., "Engineering Feasibility Report of a Proposed Dam and Lake on Sinking Creek, Potter Township, Centre County, Pennsylvania," Harrisburg: Pennsylvania Fish Commission, May 27, 1964.

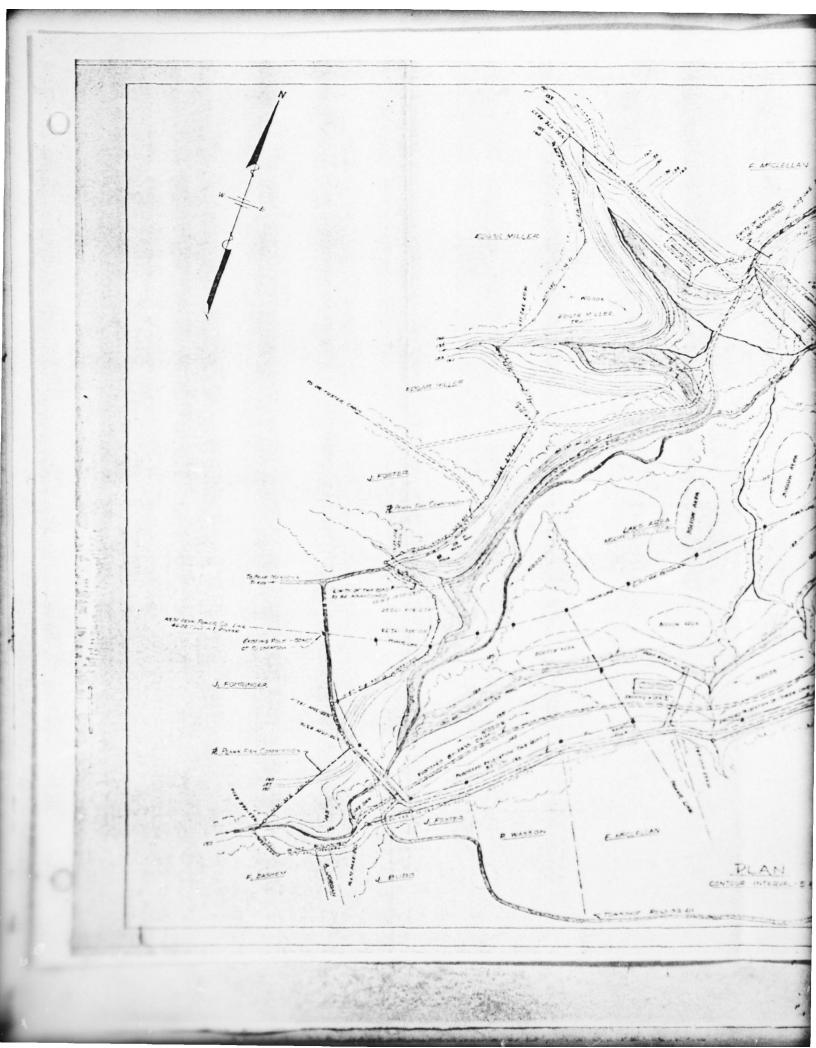


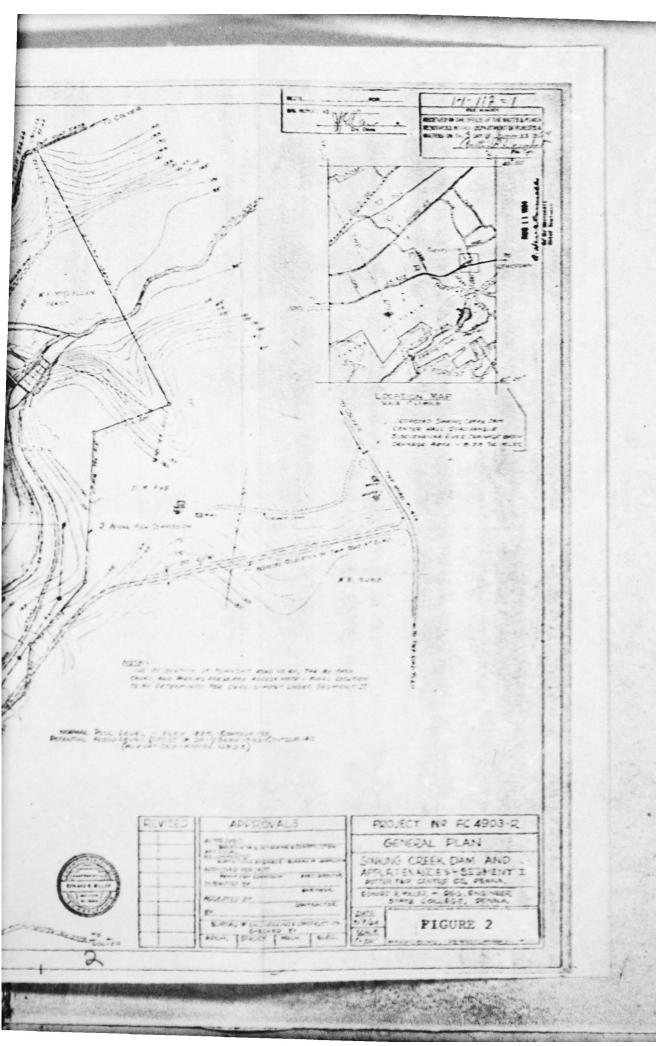
APPENDIX F

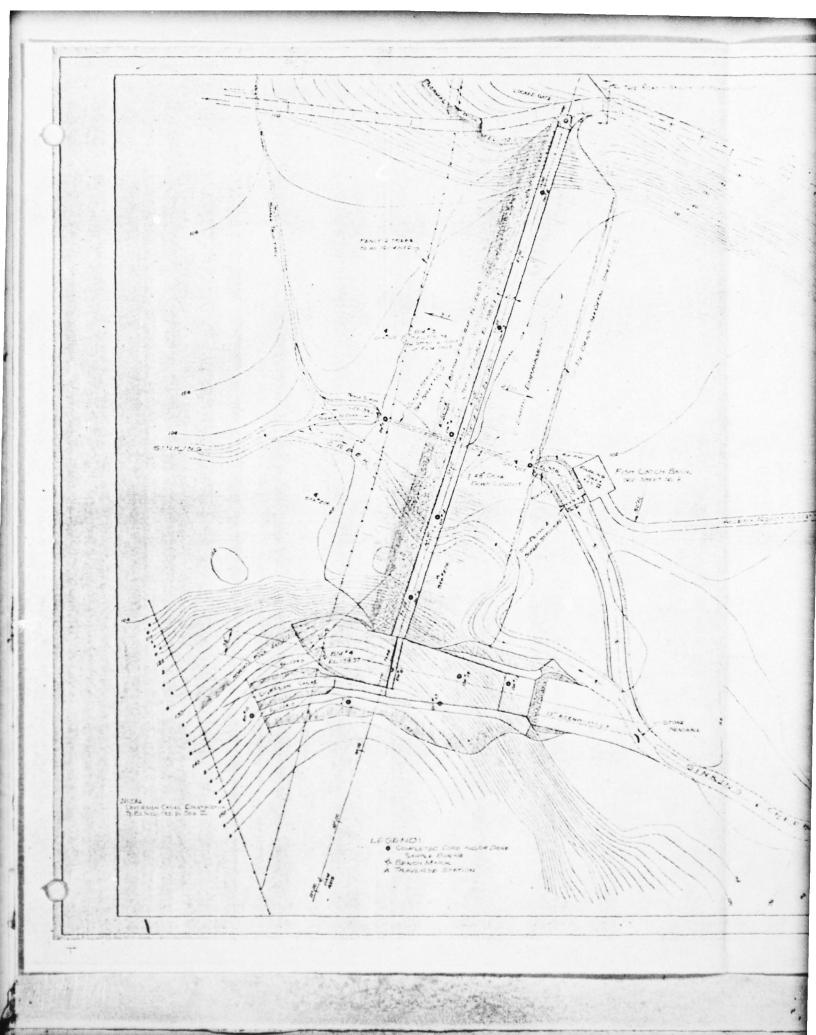
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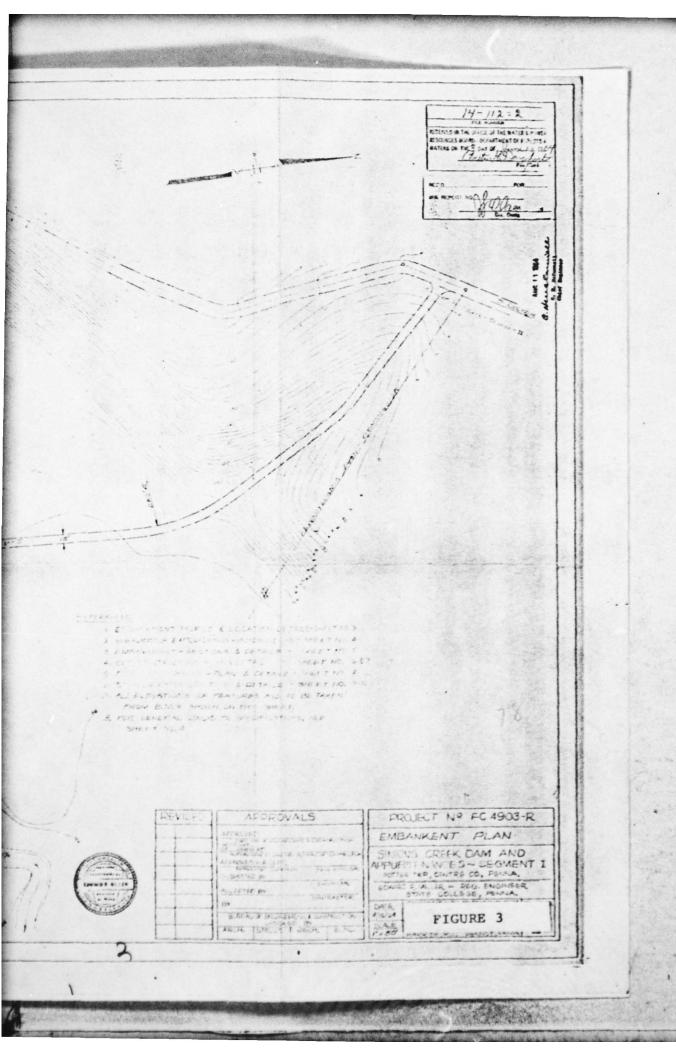
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2	General Plan
3	Embankment Plan
4	Centerline - Embankment Profile
5	Boring Logs
6	Embankment Cross Sections
7	Control Tower and Conduit
8	Fabricated Steel Details
9	Fish Catch Basin
10	Spillway - Plan and Profile
11	Repair B Center Wall at Spillway
12	Spillway - Cross Sections

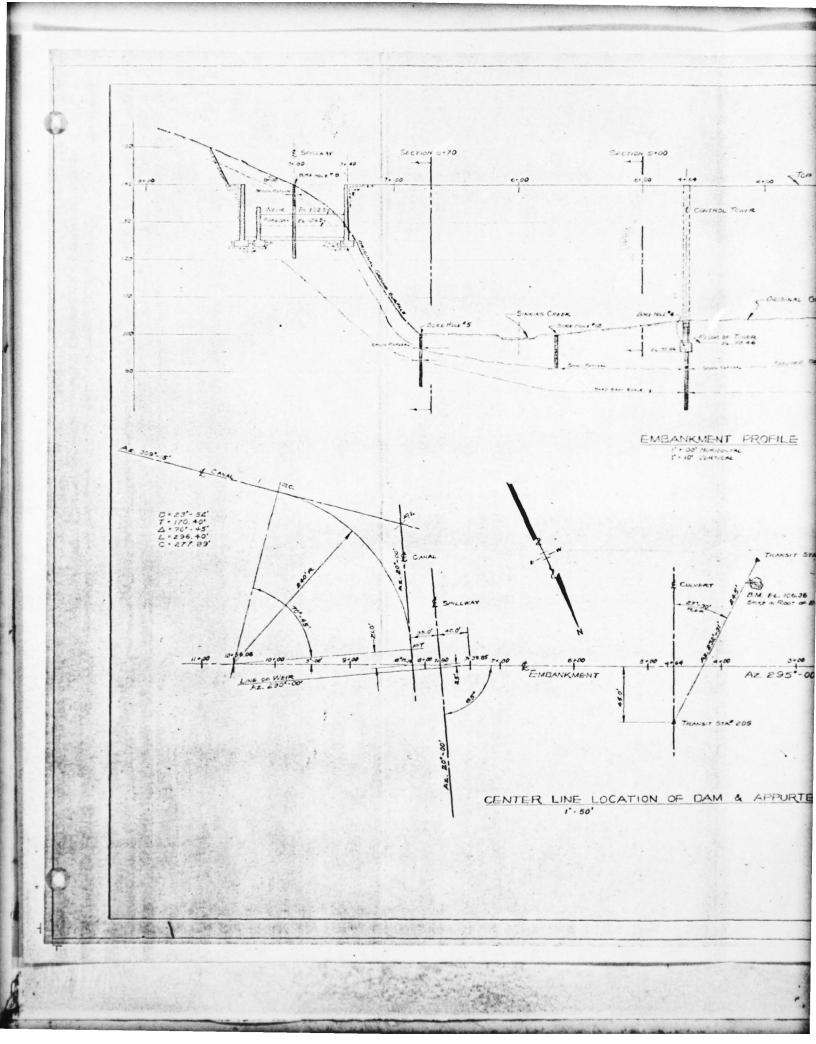


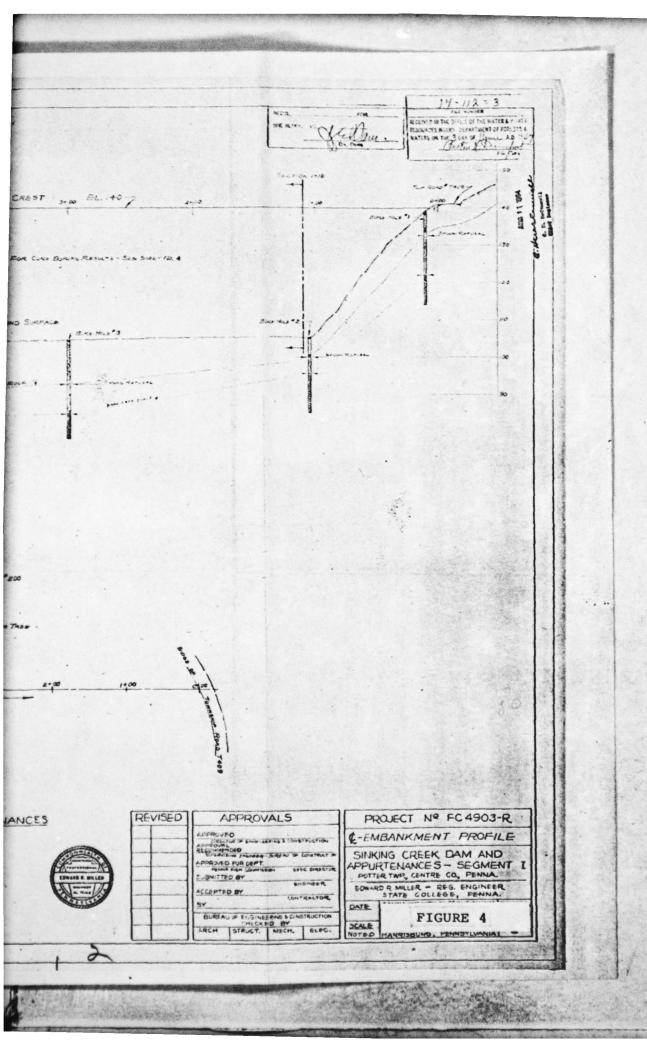


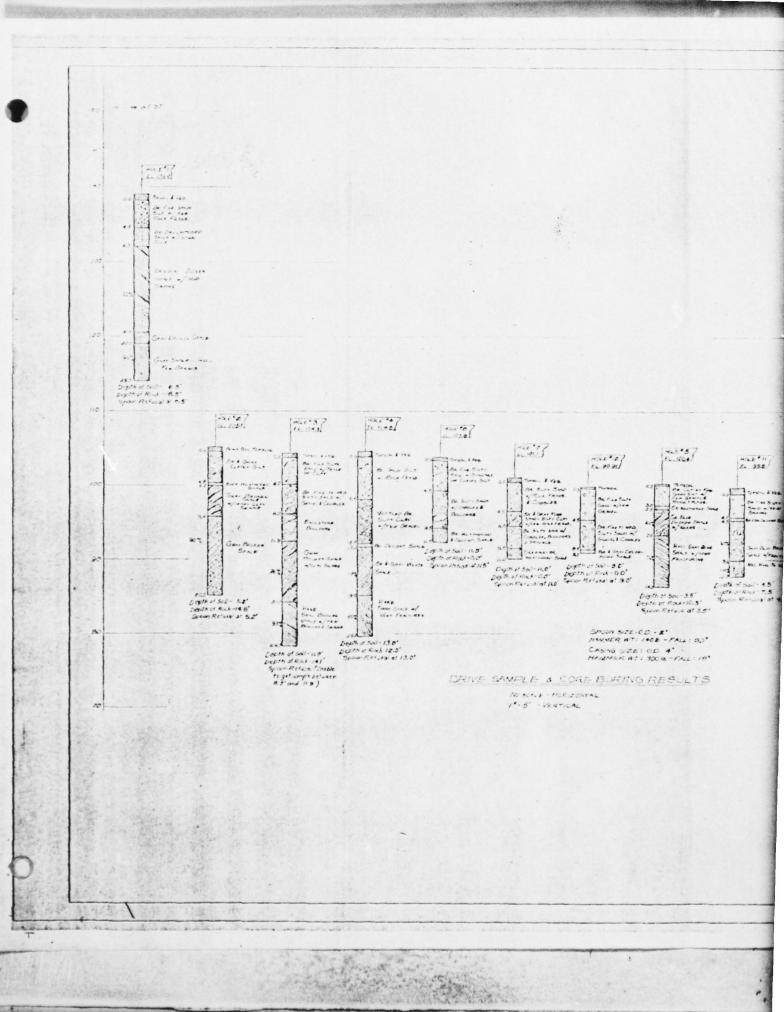


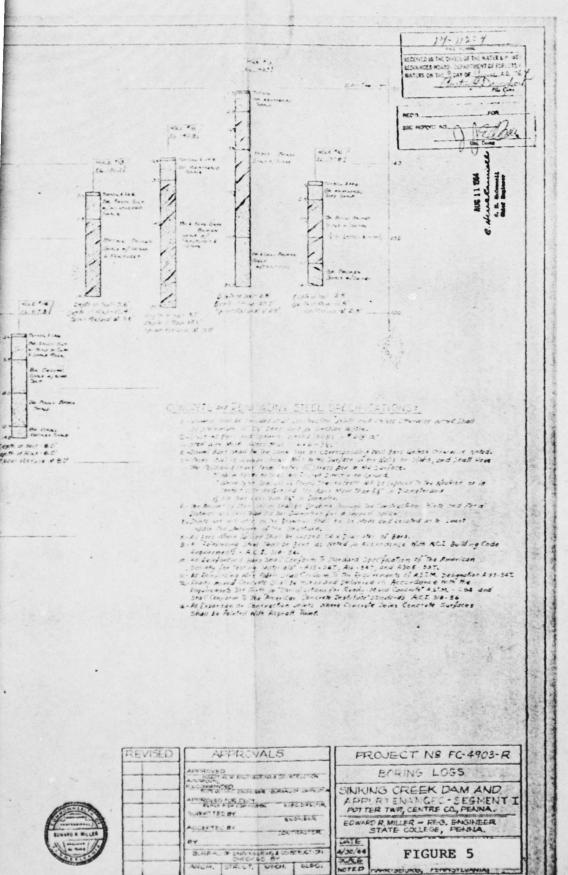




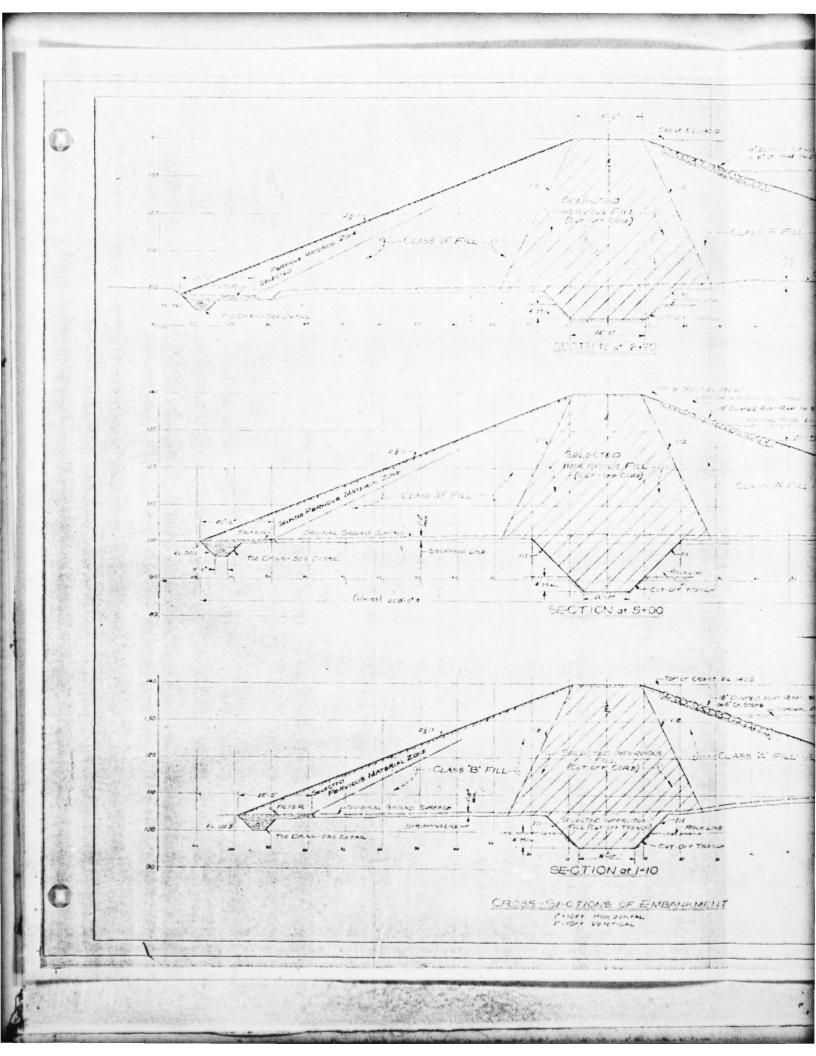


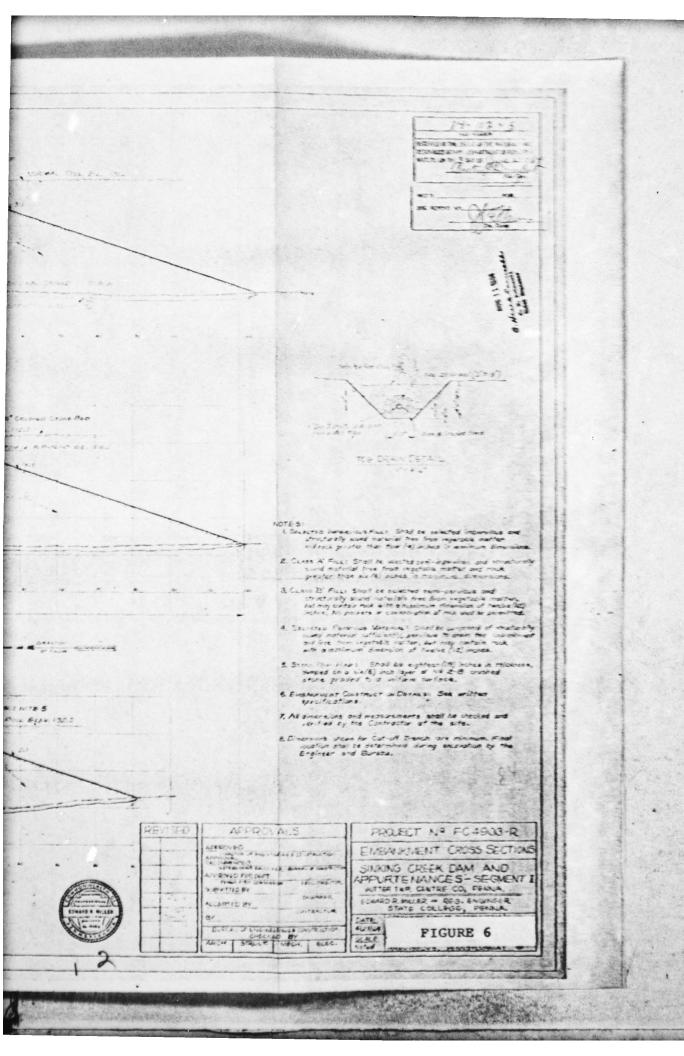


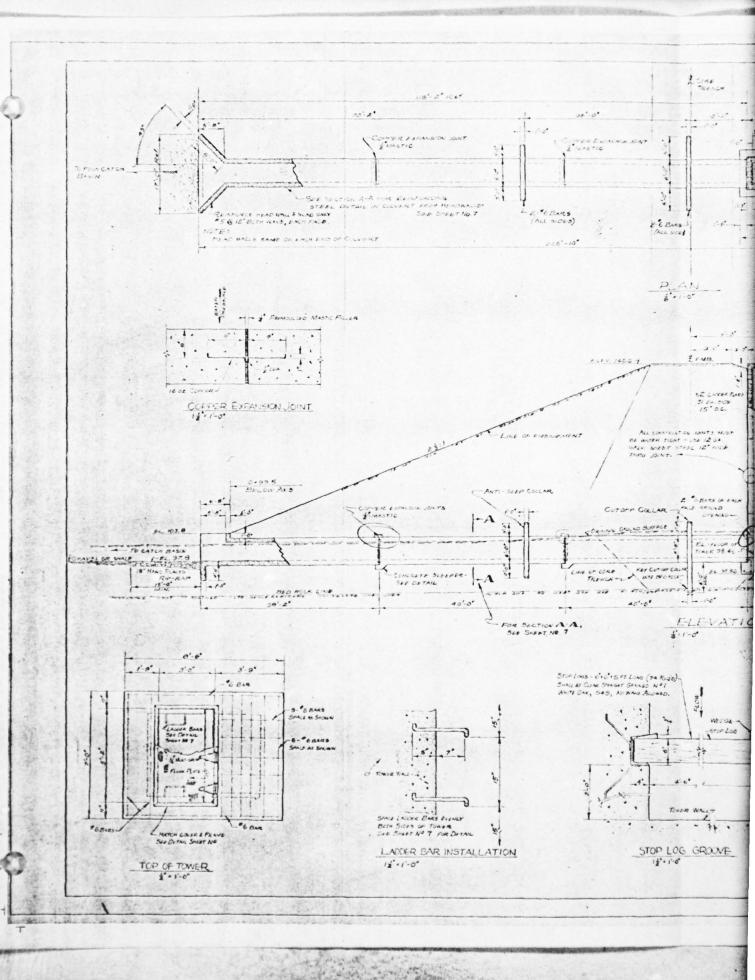


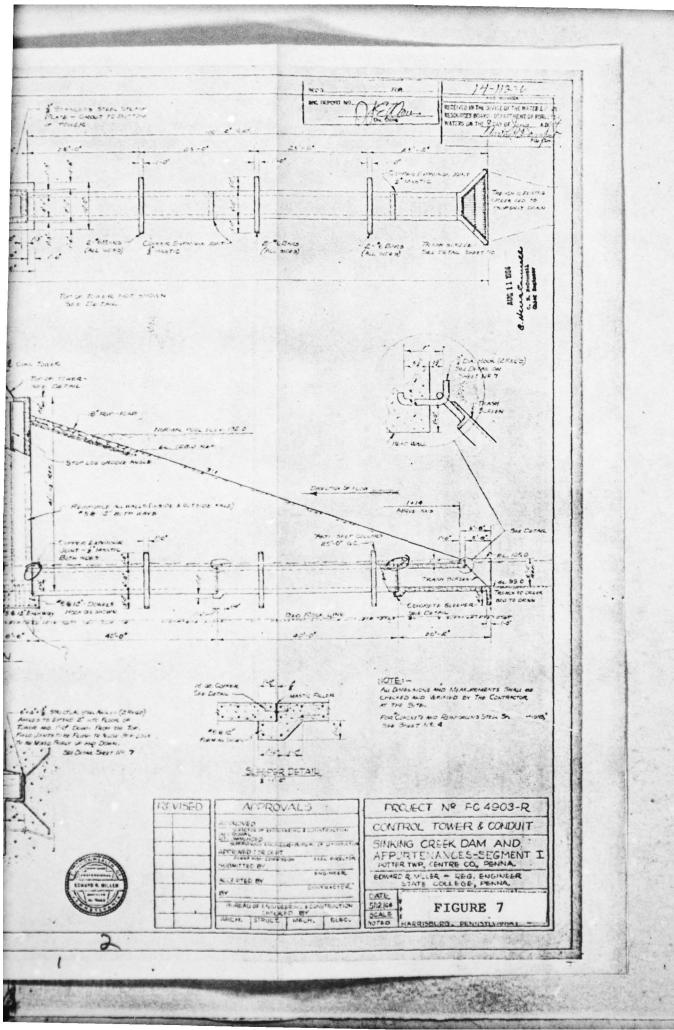


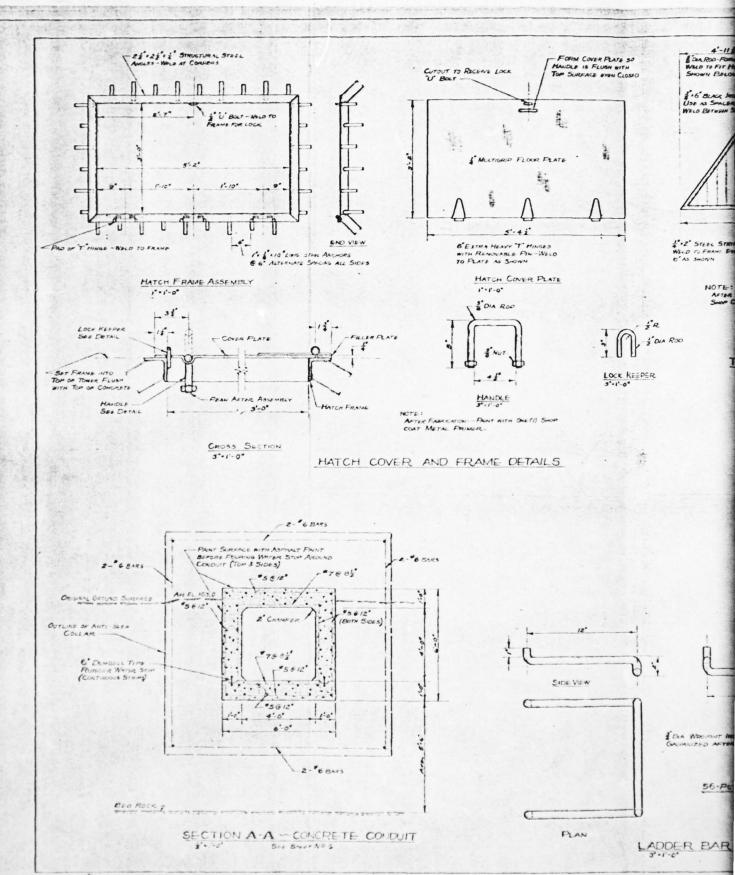
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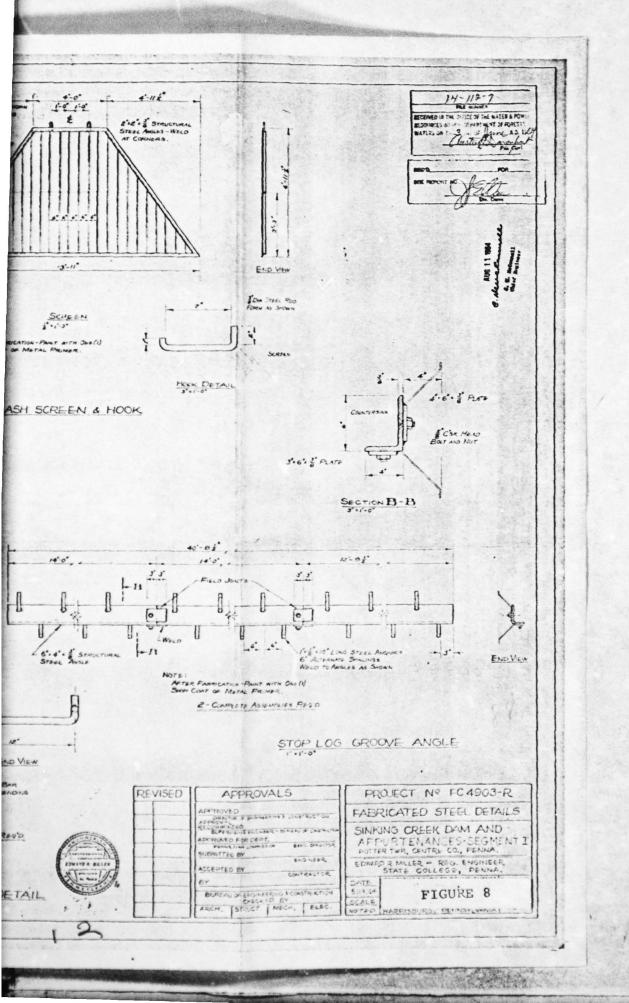






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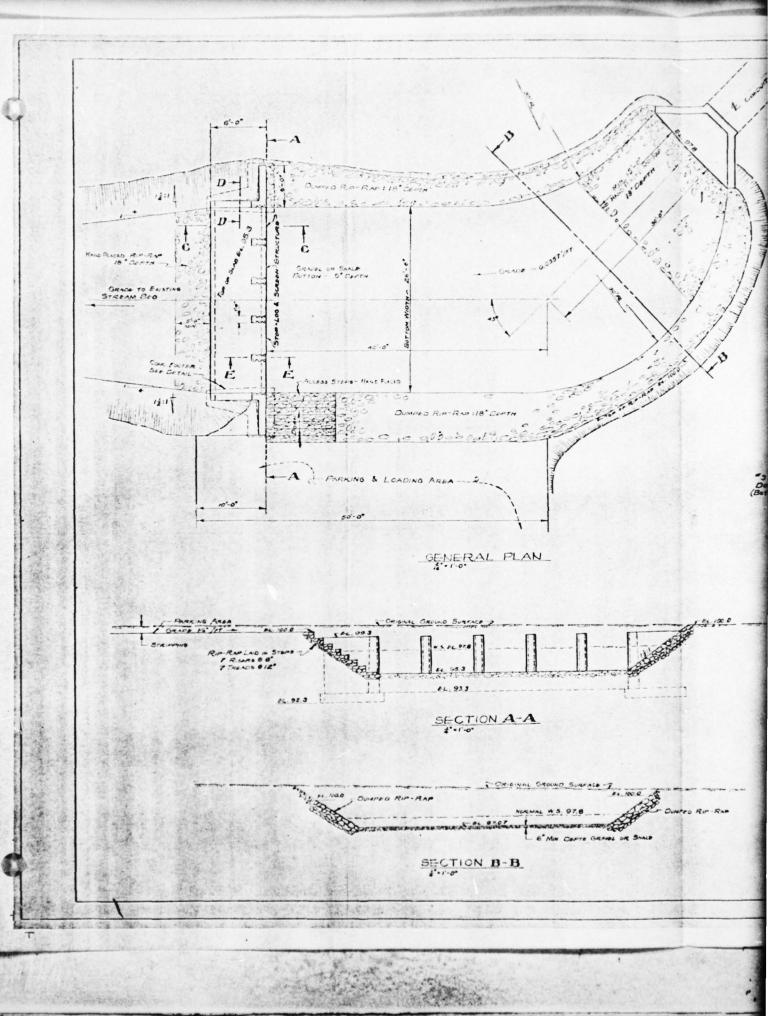
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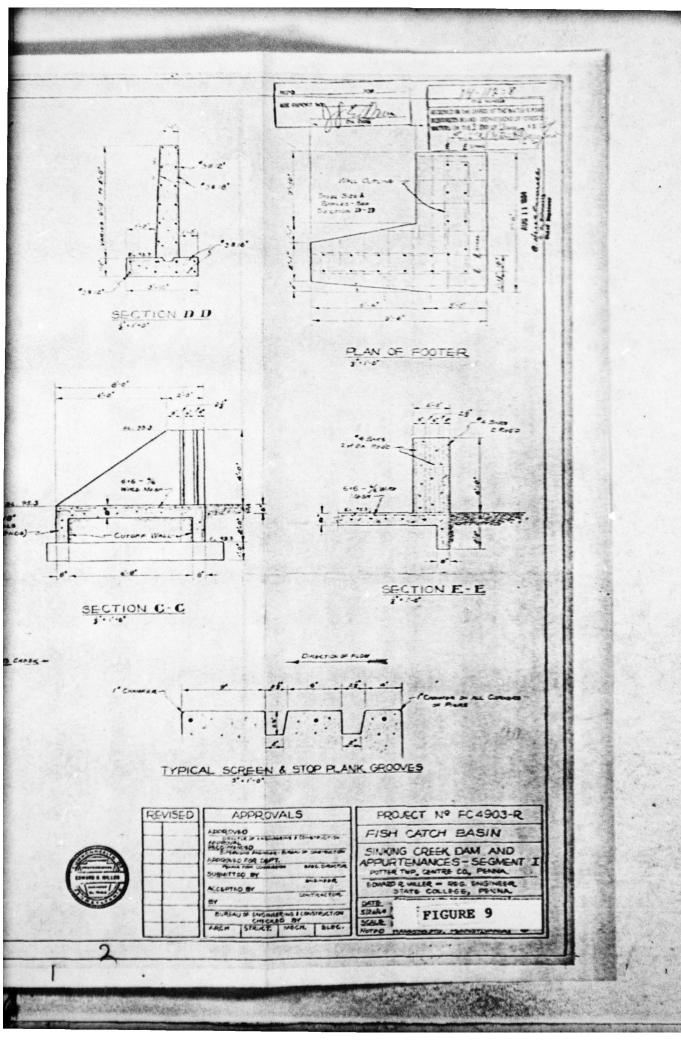
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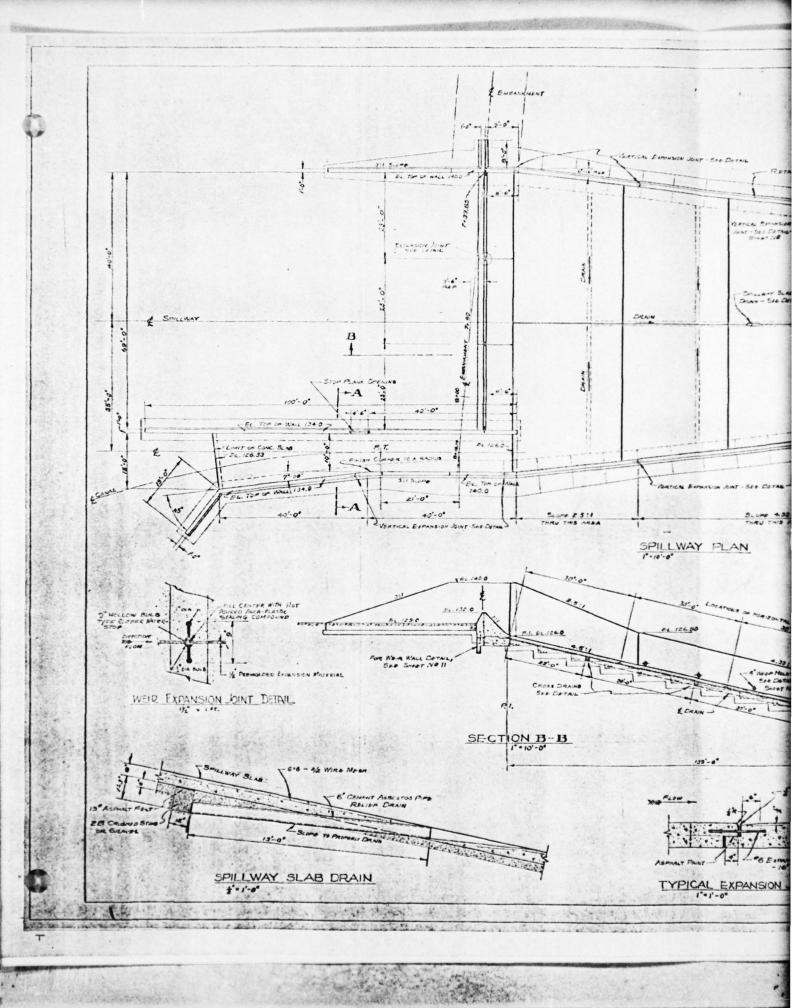
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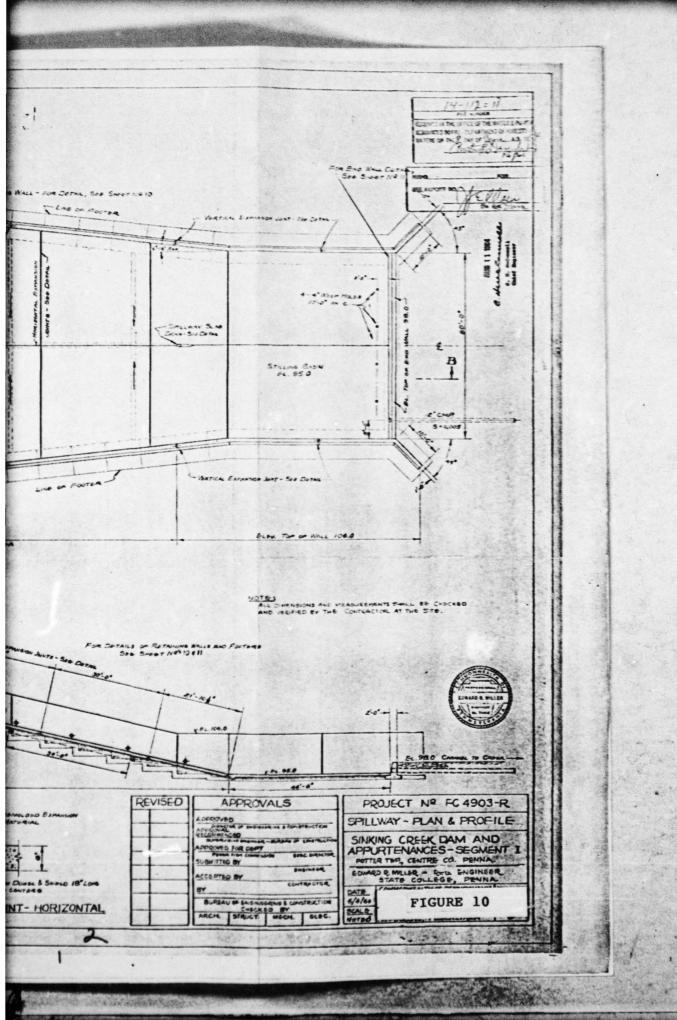
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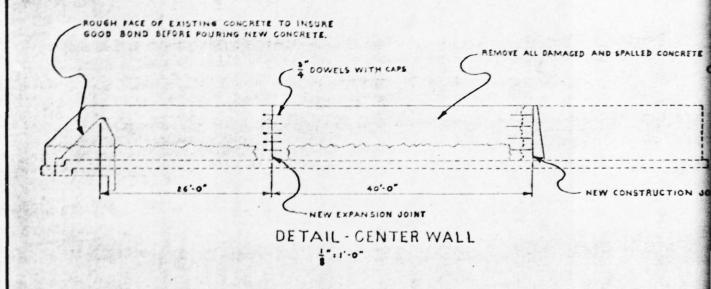
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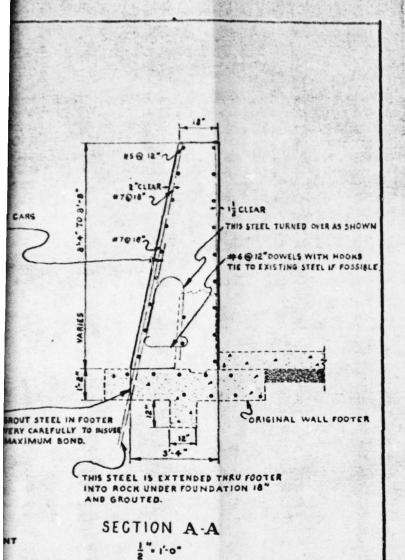




NOTE:

ALL DOWELS AND ROOS WERE GROUTED WITH "POR-ROK"
A FAST SETTING CEMENT AS MANUFACTURED BY
HALLEMITE MANUFACTURING CO. BEFORE NEW CONCRETE
WALL WAS POUREY,

MAKE SURE ALL EXPOSED CONCRETE IS CLEAN AND WET SOWN BEFORE POURING NEW CONCRETE.



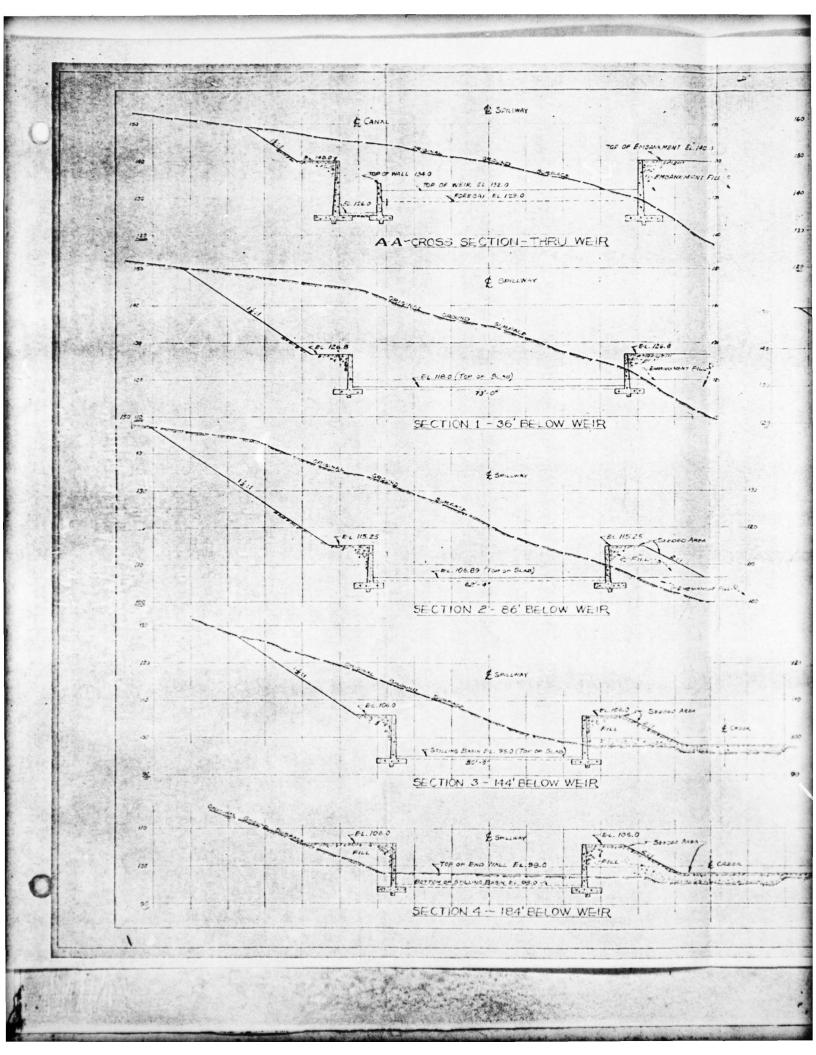
COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA FISH COMMISSION
ENGINEERING DIVISION~ BELLEFONTE RD.3, PA.
REPAIRS TO CENTER WALL AT SPILLWAY

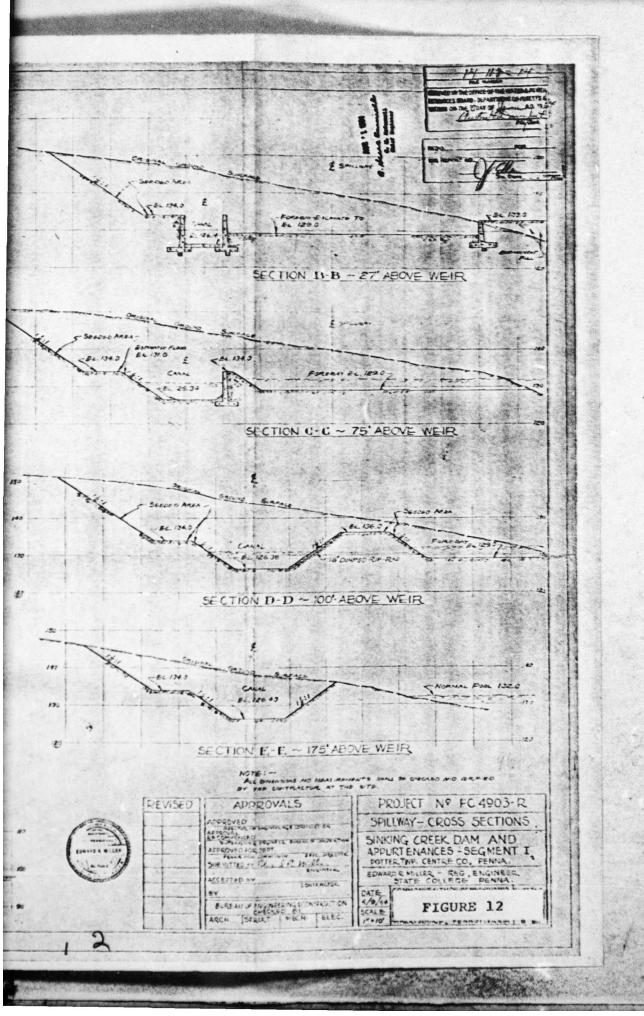
AT

COLYER DAM
POTTER TWR-GENTER CO., PENNA.

DRAWN BY: 11 W.B.
DATE: 5-7-68
APPROVED BY: R.F.
DATE: 5-10-68

FIGURE 11
NOTED





APPENDIX G

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP

